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THE

# BOTANIC GARDEN.

A POEM.

P. Bryant's 1804

THE

# BOTANIC GARDEN.

A POEM,

IN TWO PARTS.

## PART I.

CONTAINING

## THE ECONOMY OF VEGETATION.

## PART II.

## THE LOVES OF THE PLANTS.

WITH

PHILOSOPHICAL NOTES.

*The firſt American Edition.*

*NEW-YORK:*
Printed by T. & J. SWORDS, Printers to the Faculty of Phyſic
of Columbia College, No. 99 Pearl-ſtreet.

1798.

TMI

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# ADVERTISEMENT
## TO THE
## AMERICAN EDITION.

THE ſucceſs of "THE BOTANIC GARDEN" has been ſo great in Europe, and its reputation is ſo well eſtabliſhed in America, that it would betray a culpable vanity in the Publiſhers, were they to attempt, by any thing that they could offer in this place, to recommend the Poem to the further patronage of their fellow-citizens. They may be indulged, however, in a few remarks on the advantages of the preſent edition.

The London copy, in quarto, ſells for *twelve dollars* and upwards in America; a price which readers of Poetry, and even ſtudents of Nature, in this country, can ſeldom conveniently pay. It is, beſide, more adapted for a library than for daily uſe.

The Dublin edition, in octavo, which has principally circulated in the United States, is deficient both in correctneſs and in many plates, eſſential to the thorough comprehenſion of ſeveral parts of the work. It is in two ſeparate volumes; and bears a price diſproportionate to its value as a book.

In the preſent edition, the Publiſhers have endeavoured to reconcile the two extremes; and to attain convenience and cheapneſs, without any cenſurable ſacrifice of correctneſs and elegance. In their edition, the Poem is comprized in a ſingle volume of commodious form; the type and paper are ſuperior to thoſe of the Iriſh, and, perhaps, not inferior to thoſe of the Engliſh copies; no plates, but ſuch as are merely ornamental, and of theſe only four out of twenty-one plates in all, have been omitted; thoſe which are inſerted are executed in the beſt manner the ſtate of the arts in this city will admit: and there is reaſon to believe that few errors are diſcoverable in the letter-preſs.

On the whole, the Publiſhers venture to believe that they ſhall be found to have fulfilled every expectation which they raiſed by their propoſals; and that they ſhall have acquitted themſelves, in this undertaking, to general ſatisfaction.

*New-York, March* 20, 1798.

# EPISTLE

## *TO THE AUTHOR OF THE BOTANIC GARDEN.*

FOR unknown ages, 'mid his wild abode,
Speechless and rude, the human savage trode;
By slow degrees expressive sounds acquired,
And simple thoughts in words uncouth attired.
As growing wants and varying climes arise,
Excite desire and animate surprize,
Gradual his mind a wider circuit ranged,
His manners soften'd, and his language changed;
And grey experience, wiser than of yore,
Bequeath'd its strange traditionary lore.

Again long ages mark the flight of time,
And lingering toil evolves the *Art* divine.
Coarse drawings, first, the imperfect thought reveal'd;
Next, barbarous forms the mystic sense conceal'd;
Capricious signs the meaning, then, disclose;
And, last, the infant alphabet arose:
From Nilus' banks adventurous CADMUS errs,
And on his Thebes the peerless boon confers.

Slow spread the sacred art, its use was slow:
Whate'er the improvements later times bestow,
Still how restrain'd, how circumscrib'd, its power!
Years raise the fruit an instant may devour.
Fond SCIENCE wept; the uncertain toil she view'd,
And, in the evil, half forgot the good.
What tho' the sage, and tho' the bard inspired,
By truth illumined, and by genius fired,
In high discourse the theme divine prolong,
And pour the glowing tide of lofty song;
To princes limited, to Plutus' sons,
Tyrants of mines and heritors of thrones,

The theme, the song, scarce toucht the general mind;
Lost, or secluded from opprest mankind.
Fond SCIENCE wept; how vain her cares she saw,
Subject to Fortune's ever-varying law.
Month after month a single transcript claim'd,
The style perchance, perchance the story, maim'd;—
* The guides to truth corrupted, or destroy'd,
A passage foisted, or a painful void,
The work of ignorance, or of fraud more bold,
To blast a rival, or a scheme uphold;—
Or, in the progress of the long review,
The original perisht as the copy grew;
Or, perfect both, while pilgrim bands admire,
The instant prey of accidental fire.
Fond SCIENCE wept; whate'er of costliest use,
The gift and glory of each favouring Muse;
From every land what genius might select;
What wealth might purchase, and what power protect;
The guides of youth, the comforters of age;
Swept by the besom of barbaric rage,—
Scarce a few fragments scatter'd o'er the field,—
Frantic, in one sad moment, she beheld.
" Nor shall such toil my generous sons subdue;
" Nor waste like this again distress the view!"
She cries:—where Harlem's classic groves
Embowering rise, with silent flight she moves;
She marks LAURENTIUS carve the beechen rind,
And darts a new creation on his mind:
A sudden rapture thrills the conscious shades;
The gift remains, the bounteous vision fades.
Homeward, entranced, the Belgic Sire returns;
New hope inspires him, and new ardor burns;
Secret, he meditates his art by day;
By night fair phantoms o'er his fancy stray;
With opening morn they rush upon his soul,
Nor cares, nor duties, banish nor control;
Haunt his sequestered path, his social scene,
And, in his prayers, seductive, intervene;

---

* The four following lines were ſupplied by a friend.

Till, shaped to method, simple, and complete,
The filial ear the joyful tidings greet.*
—First, their nice hands the temper'd *letter* frame,
Alike in height, in width, in depth, the same;
Deep in the *matrices* secure infold,
And fix within, and *justify*, the *mould;*
The red *amalgam* from the cauldron take,
And flaming pour, and, as they pour it, shake;
On the *hard table* spread the *type* congeal'd,
And smooth and polish on its marble field;
While, as his busy fingers either plies,
The embrion parts of future volumes rise.
—Next, with wise care, the slender *plate* they choose,
Of shining steel, and fit, with harden'd screws,
The shifting *sliders*, which the varying line
Break into parts, or yet as one confine;
Whence, firmly bound, and fitted for the *chase*,
*Imposed*, it rests upon the stony base;
Till, hardly driven, the many-figured *quoins*
Convert to *forms* the accumulated lines.
—Then, with new toil, the upright frame they shape,
And strict connect it by the solid *cap;*
The moving *head* still more the frame combines;
The guiding *shelf* its humbler tribute joins;
While the stout *winter* erring change restrains,
And bears the carriage, and the press sustains:
The *platten* these, and *spindle* well connect,
Four slender bars support it, and direct,
As the high handle, urging from above,
Downwards and forceful bids its pressure move:
Beneath, with *plank* the patient *carriage* spread,
Lifts the smooth marble on its novel bed,
Rides on its wheeled *spit* in rapid state,
Nor fears to meet the quick-descending weight.
—Last, the wise Sire the ready *form* supplies,
With cautious hands and scrutinizing eyes;

* Laurentius first confided the secret of his discovery to his son-in-law.—The reasons for the subsequent deviations from historical accuracy, will be obvious to the poetic reader.

Fits the moist *tympan*,—(while the Youth, intent,
With *patting balls*, applies the sable paint,)
Then lowers the *frisket*, turns the flying *rounce*,
And pulls amain the forceful *bar* at once;
A second turn, a second pressure, gives,
And on the sheet the fair impression lives.
Raptured, the Youth and reverend Sire behold,
Press to their lips and to their bosoms fold;
Mingle their sighs, ecstatic tears descend,
And, face to face, in silent union blend:
Fond SCIENCE triumphs, and rejoicing Fame,
From pole to pole, resounds LAURENTIUS' name.

Hence, doom'd no more to barbarous zeal a prey,
Genius and Taste their treasured stores display;
Nor lords, nor monks, alone, the sweets procure,
But old and young, the humble and the poor.

Hence, wide diffused, increasing knowlege flies,
And error's shades forsake the jaundiced eyes;
Man knows himself for man, and sees, elate,
The kinder promise of his future fate;
Nations, ashamed, their ancient hate forego,
And find a brother, where they found a foe.

Hence, o'er the world,—(what else perchance conceal'd,
Suppress for ages, or fore'er withheld,
To one small town, or shire, or state, confined,
In merit's spite to long neglect consign'd,
The sport or victim of some envious flame,
Whence care nor art might rescue nor reclaim,)—
Flies the BOTANIC SONG; around
Successive nations catch the enchanting sound,
Glow as they listen, wonder as they gaze,
And pay the instructive page with boundless praise:
For not to Britain's parent isle alone,
Or what the East encircles with her zone,
The bounty flows; but spreads to neighbouring realms,
And a *new hemisphere* with joy o'erwhelms.

## TO Dr. DARWIN.

*Here*, read with rapture, studied with delight,
Long shall it charm the taste, the thought excite;
And youths and maids, the parent and the child,
Their minds illumined, and their griefs beguiled,
By all of fancy, all of reason, moved,
Rise from the WORK invigor'd and improved.

Nor only *here*, nor only *now*, enjoy'd:—
Where opes the interior desolate and void;
Where Mississippi's turbid waters glide,
And white Missouri pours its rapid tide;
Where vast Superior spreads its inland sea,
And the pale tribes near icy confines stray;
" Where now Alaska lifts its forests rude,
" And Nootka rolls her solitary flood;"*
Where the fierce sun with ray severer rains
His floods of light o'er Amazonian plains;
Where, land of horrors! roam the giant brood,
On the bleak margin of the antarctic flood;
In future years, in ages long to come,—
When redient Justice finds again her home;—
Known, honour'd, studied, graced with nobler fame,
Its charms unfaded, and its worth the same,
To vaster schemes shall light the kindling view,
And lift to heights no earlier era knew.
Some ardent youth, some Fair whose beauties shine,
In mind, as person, only not divine,—
In halls where Montezuma erst sat throned,
Whom thirty princes as their sovereign own'd;—
In bowers where Manco labour'd for Peru,
While the white thread his blest Oëlla drew,—
Where Ataliba met a tyrant's rage,—
Entranced, shall ponder o'er the various page;
Or, where Oregon foams along the West,
And seeks the fond Pacific's tranquil breast,

---

* This couplet is from an unpublished Poem of my friend Mr. Richard Alsop; a poet who, were his ambition equal to his talents, would appear among the poets of his time " *velut inter ignes luna minores.*"

### TO

# *THE AUTHOR*

### OF THE

# POEM ON THE LOVES OF THE PLANTS.

### *BY THE REV. W. B. STEVENS.*

OFT tho' thy genius, DARWIN! amply fraught
  With native wealth, explore new worlds of mind;
Whence the bright ores of drossless wisdom brought,
  Stampt by the Muse's hand, enrich mankind;

Tho' willing Nature to thy curious eye,
  Involved in night, her mazy depths betray;
Till at their source thy piercing search descry
  The streams, that bathe with Life our mortal clay;

Tho', boldly soaring in sublimer mood
  Through trackless skies, on metaphysic wings,
Thou darest to scan the approachless Cause of Good,
  And weigh, with stedfast hand, the sum of Things;

Yet wilt thou, charm'd amid his whispering bowers,
  Oft with lone step by glittering Derwent stray,
Mark his green foliage, count his musky flowers,
  That blush or tremble to the rising ray;

While FANCY, seated in her rock-roof'd dell,
  Listening the secrets of the vernal grove,
Breathes sweetest strains to thy symphonious shell,
  And "gives new echoes to the throne of Love."

*Repton, Nov.* 28, 1788.

### TO

## DR. DARWIN.

WHILE Sargent winds, with fond and curious eyes,
Thro' every mazy region of "the mine——"
While, as entrancing forms around him rise,
With magic light the mineral kingdoms shine;

Behold! amid the vegetable bloom,
O DARWIN, thy ambrosial rivers flow,
And suns more pure the fragrant earth illume,
As all the vivid plants with passion glow.

Yes!—and, where'er with life creation teems,
I trace thy spirit thro' the kindling whole;
As with new radiance to the genial beams
Of Science, isles emerge, or oceans roll,
And *Nature*, in primordial beauty, seems
To breathe, inspir'd by Thee, the PHILOSOPHIC SOUL!

R. POLWHELE.

*Kenton, near Exeter, April* 18, 1792.

---

### TO

## DR. DARWIN.

TWO Poets, (poets, by report,
Not oft so well agree)
Sweet harmonist of Flora's court!
Conspire to honour Thee.

They best can judge a poet's worth,
Who oft themselves have known
The pangs of a poetic birth,
By labours of their own,

We, therefore, pleas'd, extol thy song,
Though various yet complete,
Rich in embellishment, as strong
And learn'd as it is sweet.

No envy mingles with our praise,
Though could our hearts repine
At any Poet's happier lays,
They would, they must, at thine.

But we in mutual bondage knit
Of Friendship's closest tie,
Can gaze on even DARWIN's wit
With an unjaundic'd eye;

And deem the bard, whoe'er he be,
And howsoever known,
Who would not twine a wreath for Thee,
Unworthy of his own.

WM. COWPER,

*Weston Underwood, Olney, Bucks, June 23, 1793.*

---

TO

## DR. DARWIN.

AS Nature lovely Science led
Thro' all her flow'ry maze,
The volume she before her spread
Of DARWIN's radiant lays.

Coy Science starts—so started Eve
At beauties yet unknown:
"The figure that you there perceive
(Said Nature) is your own."

" My own? It is:—but half so fair
  " I never seem'd till now:
" And here, too, with a soften'd air,
  " Sweet Nature! here art Thou."

" Yes—in this mirrour of the Bard
  " We both embellish'd shine;
" And grateful will unite to guard
  " An artist so divine."——

Thus Nature and thus Science spake
  In Flora's friendly bower;
While DARWIN's glory seem'd to wake
  New life in every flower.

This with delight two Poets heard;
  Time verifies it daily;
Trust it, dear DARWIN, on the word
  Of COWPER and of HAYLEY!—

W. HAYLEY.

*Earthan, near Chichester, June 27, 1792.*

### *Addreſs to the River Derwent, on whoſe Banks the Author of the Botanic Garden reſides.*

*By F. N. C. MUNDY, Eſq.* 1792.

DERWENT, like thee thy Poet's splendid song
  With sweet vicissitudes of ease and force
Now with enchanting smothness glides along,
  Now pours impetuous its resounding course;

While Science marches down thy wond'ring dells,
  And all the Muses round her banners crowd,
Pleas'd to assemble in thy sparry cells,
  And chant her lessons to thy echoes proud;

While here Philosophy and Truth display
  The shining robes those heaven-born sisters wove,
While Fays and Graces beck'ning smooth their way,
  And hand in hand with Flora follows Love.

Well may such radiant state increase thy pride,
  Delighted stream! tho' rich in native charms,
Tho' inborn worth and honour still reside,
  Where thy chill banks the glow of Chatsworth warms.

Tho' here her new-found art, as that of yore,
  The spinster Goddess to thy rule assigns;
Tho', where her temples crowd thy peopled shore,
  Wealth gilds thy urn, and Fame thy chaplet twines.

Ah, while thy nymphs in Derby's towered vale
  Lead their sad Quires around MILCENA's bier,
What soothing sweetness breathes along the gale,
  Comes o'er the consort's heart, and balms a brother's tear!

*Her new-found art, &c.* Alluding to the numerous cotton mills on and near the river Derwent.

*Milcena's bier.* Mrs. French, ſiſter to Mrs. Mundy. Part I. Canto III. l. 308.

THE

# BOTANIC GARDEN.

## PART I.

CONTAINING

## THE ECONOMY OF VEGETATION.

*A POEM.*

WITH

## PHILOSOPHICAL NOTES.

> It Ver, et Venus; et Veneris prænuncius ante
> Pennatus graditur Zephyrus veſtigia propter;
> Flora quibus mater, præſpergens ante viai
> Cuncta, coloribus egregiis et odoribus opplet. LUCRET.

*The first American, from the third London Edition.*

*NEW-YORK:*
Printed by T. & J. SWORDS, Printers to the Faculty of Phyſic
of Columbia College, No. 99 Pearl-ſtreet.
1798.

# APOLOGY.

IT may be proper here to apologize for many of the subsequent conjectures on some articles of natural philosophy, as not being supported by accurate investigation or conclusive experiments. Extravagant theories, however, in those parts of philosophy where our knowledge is yet imperfect, are not without their use; as they encourage the execution of laborious experiments, or the investigation of ingenious deductions, to confirm or refute them. And, since natural objects are allied to each other by many affinities, every kind of theoretic distribution of them adds to our knowledge by developing some of their analogies.

The Rosicrucian doctrine of Gnomes, Sylphs, Nymphs, and Salamanders, was thought to afford a proper machinery for a Botanic poem; as it is probable, that they were originally the names of hieroglyphic figures representing the elements.

Many of the important operations of Nature were shadowed or allegorized in the heathen mythology, as the first Cupid springing from the Egg of Night, the marriage of Cupid and Psyche, the Rape of Proserpine, the Congress of Jupiter and Juno, the Death and Resuscitation of Adonis, &c. many of which are ingeniously explained in the works of Bacon, vol. v. p. 47. 4th edit. London, 1778. The Egyptians were possessed of many discoveries in philosophy and chemistry, before the invention of letters; these were then expressed in hieroglyphic paintings of men and animals; which, after the discovery of the alphabet, were described and animated by the poets, and became first the deities of Egypt, and afterwards of Greece and Rome. Allusions to those fables were therefore thought proper ornaments to a philosophical poem, and are occasionally introduced either as represented by the poets, or preserved on the numerous gems and medallions of antiquity.

# ARGUMENT

OF THE

# *FIRST CANTO.*

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THE

# BOTANIC GARDEN.

## ECONOMY OF VEGETATION.

### CANTO I.

"STAY *your rude ſteps!* whoſe throbbing breaſts infold
The legion-fiends of Glory, or of Gold!
*Stay!* whoſe falſe lips ſeductive ſimpers part,
While Cunning neſtles in the harlot-heart!—
For you no Dryads dreſs the roſeate bower,
For you no Nymphs their ſparkling vaſes pour;
Unmark'd by you, light Graces ſwim the green,
And hovering Cupids aim their ſhafts, unſeen.

"But THOU! whoſe mind the well-attemper'd ray
Of Taſte and Virtue lights with purer day;
Whoſe finer ſenſe each ſoft vibration owns
With ſweet reſponſive ſympathy of tones;
So the fair flower expands its lucid form
To meet the ſun, and ſhuts it to the ſtorm;—
For thee my borders nurſe the fragrant wreath,
My fountains murmur, and my zephyrs breathe;
Slow ſlides the painted ſnail, the gilded fly
Smoothes his fine down, to charm thy curious eye;
On twinkling fins my pearly nations play,
Or win with ſinuous train their trackleſs way;

---

*So the fair flower.* l. 13. It ſeems to have been the original deſign of the philoſophy of Epicurus to render the mind exquiſitely ſenſible to agreeable ſenſations, and equally inſenſible to diſagreeable ones.

My plumy pairs, in gay embroidery dreſs'd,
Form, with ingenious bill, the penſile neſt;
To Love's ſweet notes attune the liſtening dell,
And Echo ſounds her ſoft ſymphonious ſhell.

"And, if with Thee ſome hapleſs Maid ſhould ſtray,
Diſaſterous Love companion of her way,
Oh, lead her timid ſteps to yonder glade,
Whoſe arching cliffs depending alders ſhade;
There, as meek Evening wakes her temperate breeze,
And moon-beams glimmer through the trembling trees,
The rills, that gurgle round, ſhall ſoothe her ear,
The weeping rocks ſhall number tear for tear;
There, as ſad Philomel, alike forlorn,
Sings to the Night from her accuſtomed thorn;
While at ſweet intervals each falling note
Sighs in the gale, and whiſpers round the grot;
The ſiſter-woe ſhall calm her aching breaſt,
And ſofter ſlumbers ſteal her cares to reſt.—

"Winds of the North! reſtrain your icy gales,
Nor chill the boſom of theſe happy vales!
Hence in dark heaps, ye gathering Clouds, revolve!
Diſperſe, ye Lightnings! and, ye Miſts, diſſolve!
—Hither, emerging from yon orient ſkies,
Botanic Goddess! bend thy radiant eyes;
O'er theſe ſoft ſcenes aſſume thy gentle reign,
Pomona, Ceres, Flora in thy train;
O'er the ſtill dawn thy placid ſmile effuſe,
And with thy ſilver ſandals print the dews;
In noon's bright blaze thy vermil veſt unfold,
And wave thy emerald banner ſtarr'd with gold."

---

*Diſaſterous Love.* l. 26. The ſcenery is taken from a botanic garden about a mile from Lichfield, where a cold bath was erected by Sir John Floyer. There is a grotto ſurrounded by projecting rocks, from the edges of which trickles a perpetual ſhower of water; and it is here repreſented as adapted to love-ſcenes, as being thence a proper reſidence for the modern goddeſs of Botany, and the eaſier to introduce the next poem on the Loves of the Plants, according to the ſyſtem of Linnæus.

Thus ſpoke the Genius, as he ſtept along,
And bade theſe lawns to Peace and Truth belong;
Down the ſteep ſlopes He led, with modeſt ſkill,
The willing pathway, and the truant rill,
Stretch'd o'er the marſhy vale yon willowy mound,
Where ſhines the lake amid the tufted ground,
Rais'd the young woodland, ſmooth'd the wavy green,
And gave to Beauty all the quiet ſcene.—

She comes!—the Goddess!—through the whiſpering air,
Bright as the morn, deſcends her bluſhing car;
Each circling wheel a wreath of flowers entwines,
And gem'd with flowers the ſilken harneſs ſhines;
The golden bits with flowery ſtuds are deck'd,
And knots of flowers the crimſon reins connect.—
And now on earth the ſilver axle rings,
And the ſhell ſinks upon its ſlender ſprings;
Light from her airy ſeat the Goddeſs bounds,
And ſteps celeſtial preſs the panſied grounds.

Fair Spring advancing calls her feather'd quire,
And tunes to ſofter notes her laughing lyre;
Bids her gay hours on purple pinions move,
And arms her Zephyrs with the ſhafts of Love.
Pleas'd Gnomes, aſcending from their earthy beds,
Play round her graceful footſteps, as ſhe treads;
Gay Sylphs attendant beat the fragrant air
On winnowing wings, and waft her golden hair;
Blue *Nymphs* emerging leave their ſparkling ſtreams,
And *Fiery Forms* alight from orient beams;

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*Pleas'd Gnomes.* l. 73. The Roſicrucian doctrine of Gnomes, Sylphs, Nymphs, and Salamanders, affords proper machinery for a philoſophic poem; as it is probable that they were originally the names of hieroglyphic figures of the Elements, or of Genii preſiding over their operations. The Fairies of more modern days ſeem to have been derived from them, and to have inherited their powers. The Gnomes and Sylphs, as being more [illegible] allied to modern Fairies, are repreſented as either male or female, which diſtinguiſhes the latter from the Auræ of the Latin poets, which were only female; except the winds, as Zephyrus and Auſter, may be ſuppoſed to have been their huſbands.

Muſk'd in the roſe's lap freſh dews they ſhed,
Or breathe celeſtial luſtres round her head.

First the fine Forms her dulcet voice requires,
Which bathe or baſk in elemental fires;
From each bright gem of Day's refulgent car,
From the pale ſphere of every twinkling ſtar,
From each nice pore of ocean, earth, and air,
With eye of flame the ſparkling hoſts repair,
Mix their gay hues, in changeful circles play,
Like motes, that tenant the meridian ray.—
So the clear Lens collects, with magic power,
The countleſs glories of the midnight hour;
Stars after ſtars, with quivering luſtre fall,
And twinkling glide along the whiten'd wall.—
Pleaſed, as they paſs, ſhe counts the glittering bands,
And ſtills their murmur with her waving hands;
Each liſtening tribe with fond expectance burns,
And now to theſe, and now to thoſe, ſhe turns.

I. "*Nymphs of primeval Fire! your* veſtal train
Hung with gold treſſes o'er the vaſt inane,

*Nymphs of primeval fire.* l. 97. The fluid matter of heat is perhaps the moſt extenſive element in nature; all other bodies are immerſed in it, and are preſerved in their preſent ſtate of ſolidity or fluidity by the attraction of their particles to the matter of heat. Since all known bodies are contractible into leſs ſpace by depriving them of ſome portion of their heat, and as there is no part of nature totally deprived of heat, there is reaſon to believe that the particles of bodies do not touch, but are held towards each other by their ſelf-attraction, and recede from each other by their attraction to the maſs of heat which ſurrounds them; and thus exiſt in an equilibrium between theſe two powers. If more of the matter of heat be applied to them, they recede further from each other, and become fluid; if ſtill more be applied, they take an aërial form, and are termed Gaſſes by the modern chemiſts. Thus, when water is heated to a certain degree, it would inſtantly aſſume the form of ſteam, but for the preſſure of the atmoſphere, which prevents this change from taking place ſo eaſily; the ſame is true of quickſilver, diamonds, and of, perhaps, all other bodies in Nature; they would firſt become fluid, and then aëriform, by appropriated degrees of heat. On the contrary, this elaſtic matter of heat, termed Calorique in the new nomenclature of the French Academicians, is liable to become conſolidated itſelf in its combinations with ſome bodies, as perhaps in nitre, and probably in combuſtible bodies, as ſulphur and charcoal. See note on l. 232 of this Canto. Modern philoſophers have not yet been able to decide whether

Pierc'd with your ſilver ſhafts the throne of Night,
And charm'd young Nature's opening eyes with light;
When *Love Divine*, with brooding wings unfurl'd,
Call'd from the rude abyſs the livin[illegible]orld.
"—*Let there be Light!* proclaim'd the *Almighty* Lord,
Aſtoniſh'd Chaos heard the potent word;—
Through all his realms the kindling Ether runs,
And the maſs ſtarts into a million ſuns;

light and heat be different fluids, or modifications of the ſame fluid, as they have many properties in common. See note on l. 468 of this Canto.

*When Love Divine.* l. 101. From having obſerved the gradual evolution of the young animal or plant from its egg or ſeed; and afterwards its ſucceſſive advances to its more perfect ſtate, or maturity; philoſophers of all ages ſeem to have imagined, that the great world itſelf had likewiſe its infancy, and its gradual progreſs to maturity: this ſeems to have given origin to the very ancient and ſublime allegory of Eros, or Divine Love, producing the world from the egg of Night, as it floated in Chaos. See l. 419 of this Canto.

The external cruſt of the earth, as far as it has been expoſed to our view, in mines or mountains, countenances this opinion; ſince theſe have evidently, for the moſt part, had their origin from the ſhells of fiſhes, the decompoſition of vegetables, and the recrements of other animal materials, and muſt, therefore, have been formed progreſſively from ſmall beginnings. There are likewiſe ſome apparently uſeleſs or incomplete appendages to plants and animals, which ſeem to ſhew they have gradually undergone changes from their original ſtate; ſuch as the ſtamens without anthers, and ſtyles without ſtigmas of ſeveral plants, as mentioned in the note on Curcuma, vol. ii. of this work. Such as the halteres, or rudiments of wings of ſome two-winged inſects; and the paps of male animals; thus ſwine have four toes, but two of them are imperfectly formed, and not long enough for uſe. The allantoide in ſome animals ſeems to have become extinct; in others, is above tenfold the ſize which would ſeem neceſſary for its purpoſe. Buffon du Cochon, T. 6. p. 257. Perhaps all the ſuppoſed monſtrous births of Nature are remains of their habits of production in their former leſs perfect ſtate, or attempts towards greater perfection.

*Through all his realms.* l. 105. Mr. Herſchel has given a very ſublime and curious account of the conſtruction of the heavens, with his diſcovery of ſome thouſand nebulæ, or clouds of ſtars; many of which are much larger collections of ſtars than all thoſe put together, which are viſible to our naked eyes, added to thoſe which form the galaxy, or milky zone which ſurrounds us. He obſerves, that in the vicinity of theſe cluſters of ſtars there are proportionally fewer ſtars than in other parts of the heavens; and hence he concludes, that they have attracted each other, on the ſuppoſition that infinite ſpace was at firſt equally ſprinkled with them; as if it had, at the beginning, been filled with a fluid maſs, which had coagulated. Mr. Herſchel has further ſhewn, that the whole ſidereal ſyſtem is gradually moving round ſome centre, which may be an opake maſs of matter. Philoſ. Tranſ. V. LXXIV. If all theſe ſuns are moving round ſome great central body, they muſt have had a [illegible]ce, as well as a centripetal one; and may thence be ſuppoſed [illegible]rged or been projected from the

Earths round each ſun with quick exploſions burſt,
And ſecond planets iſſue from the firſt;
Bend, as they journey with projectile force,
In bright ellipſes th[illegible]uctant courſe;
Orbs wheel in orbs, round centres centres roll,
And form, ſelf-balanced, one revolving Whole.
—Onward they move amid their bright abode,
Space without bound, *the boſom of their* GOD!

II. "*Ethereal powers! you* chaſe the ſhooting ſtars,
Or yoke the vollied lightnings to your cars,
Cling round the aërial bow with priſms bright,
And, pleaſed, untwiſt the ſevenfold threads of light;
Eve's ſilken couch with gorgeous tints adorn,
And fire the arrowy throne of riſing Morn.
—*Or*, plum'd with flame, in gay battalions ſpring,
To brighter regions borne on broader wing;

material where they were produced. We can have no idea of a natural power which could project a ſun out of Chaos, except by comparing it to the exploſions or earthquakes owing to the ſudden evolution of aqueous or of other more elaſtic vapours; of the power of which, under immeaſurable degrees of heat and compreſſion, we are yet ignorant.

It may be objected, that if the ſtars had been projected from a Chaos by exploſions, they muſt have returned again into it from the known laws of gravitation; this, however, would not happen if the whole of Chaos, like grains of gunpowder, was exploded at the ſame time, and diſperſed through infinite ſpace at once, or in quick ſucceſſion, in every poſſible direction. The ſame objection may be ſtated againſt the poſſibility of the planets having been thrown from the ſun by exploſions; and the ſecondary planets from the primary ones, which will be ſpoken of more at large in the ſecond Canto. But if the planets are ſuppoſed to have been projected from their ſuns, and the ſecondary from the primary ones, at the beginning of their courſe, they might be ſo influenced or diverted by the attractions of the ſuns, or ſun, in their vicinity, as to prevent their tendency to return into the body from which they were projected.

If theſe innumerable and immenſe ſuns, thus riſing out of Chaos, are ſuppoſed to have thrown out their attendant planets by new exploſions, as they aſcended; and thoſe, their reſpective ſatellites, filling, in a moment, the immenſity of ſpace with light and motion, a grander idea cannot be conceived by the mind of man.

*Chaſe the ſhooting ſtars.* l. 115. The meteors called ſhooting ſtars, the lightning, the rainbow, and the clouds, are phenomena of the lower regions of the atmoſphere. The twilight, the meteors called fire-balls, or flying dragons, and the northern lights, inhabit the higher regions of the atmoſphere. See additional notes, No. I[illegible]

*Cling round the aërial bow.* l. 1[illegible]ional notes, No. II.

*Eve's ſilken couch.* l. 119. See a[illegible]es, No. III.

Where lighter gaſes, circumfus'd on high,
Form the vaſt concave of exterior ſky;
With airy lens the ſcatter'd rays aſſault, 125
And bend the twilight round the duſk[illegible]ult;
Ride, with broad eye and ſcintillating hair,
The rapid Fire-ball through the midnight air;

*Where lighter gaſes.* l. 123. Mr. Cavendiſh has ſhewn, that the gas called inflammable air, is at leaſt ten times lighter than common air: Mr. Lavoiſier contends, that it is one of the component parts of water, and is by him called hydrogene. It is ſuppoſed to afford their principal nouriſhment to vegetables, and thence to animals, and is perpetually riſing from their decompoſition; this ſource of it in hot climates, and in ſummer months, is ſo great as to exceed eſtimation. Now, if this light gas paſſes through the atmoſphere, without combining with it, it muſt compoſe another atmoſphere over the aërial one, which muſt expand, when the preſſure above it is thus taken away, to inconceivable tenuity.

If this ſupernatural gaſſeous atmoſphere floats upon the aërial one, like ether upon water, what muſt happen? 1. It will flow from the line, where it will be produced in the greateſt quantities, and become much accumulated over the poles of the earth. 2. The common air, or lower ſtratum of the atmoſphere, will be much thinner over the poles than at the line; becauſe, if a glaſs globe be filled with oil and water, and whirled upon its axis, the centrifugal power will carry the heavier fluid to the circumference, and the lighter will, in conſequence, be found round the axis. 3. There may be a place at ſome certain latitude between the poles and the line on each ſide the equator, where the inflammable ſupernatant atmoſphere may end, owing to the greater centrifugal force of the heavier aërial atmoſphere. 4. Between the termination of the aërial and the beginning of the gaſſeous atmoſphere, the airs will occaſionally be intermixed, and thus become inflammable by the electric ſpark. Theſe circumſtances will aſſiſt in explaining the phenomena of fire-balls, northern lights, and of ſome variable winds, and long continued rains.

Since the above note was firſt written, Mr. Volta, I am informed, has applied the ſuppoſition of a ſupernatant atmoſphere of inflammable air, to explain ſome phenomena in meteorology. And Mr. Lavoiſier has announced his deſign to write on this ſubject. Traité de Chimie, Tom. I. I am happy to find theſe opinions ſupported by ſuch reſpectable authority.

*And bend the twilight.* l. 126. The crepuſcular atmoſphere, or the region where the light of the ſun ceaſes to be refracted to us, is eſtimated by philoſophers to be between 40 and 50 miles high, at which time the ſun is about 18 degrees below the horizon; and the rarity of the air is ſuppoſed to be from 4000 to 10,000 times greater than at the ſurface of the earth. Cotes's Hydroſt. p. 123. The duration of twilight differs in different ſeaſons and in different latitudes. In England the ſhorteſt twilight is about the beginning of October and of March; in more northern latitudes, where the ſun never ſinks more than 18 degrees below the horizon, the twilight continues the whole night. The time of its duration may alſo be occaſionally affected by the varying height of the atmoſphere. A number of obſervations on the duration of twilight in different latitudes might afford conſiderable information concerning the aërial ſtrata in the higher regions of the atmoſphere, and might aſſiſt in d[illegible]ether an exterior atmoſphere of inflammable gas, or Hydrogen[illegible]r the aërial one.

Dart from the North on pale electric ſtreams,
Fringing Night's ſable robe with tranſient beams.
—*Or* rein the Planets in their ſwift careers,
Gilding with borro[illegible]ght their twinkling ſpheres;
Alarm with comet-blaze the ſapphire plain,
The wan ſtars glimmering through its ſilver train;
Gem the bright Zodiac, ſtud the glowing pole,
Or give the Sun's phlogiſtic orb to roll.

III. *Nymphs! your* fine forms with ſteps impaſſive mock
Earth's vaulted roofs of adamantine rock;
Round her ſtill centre tread the burning ſoil,
And watch the billowy Lavas as they boil;
Where, in baſaltic caves impriſon'd deep,
Reluctant fires in dread ſuſpenſion ſleep;
Or ſphere on ſphere in winding waves expand,
And glad with genial warmth the incumbent land.
So when the Mother-bird ſelects their food
With curious bill, and feeds her callow brood;
Warmth from her tender heart eternal ſprings,
And, pleas'd, ſhe claſps them with extended wings.

"*You* from deep cauldrons and unmeaſur'd caves
Blow flaming airs, or pour vitreſcent waves;
O'er ſhining oceans ray volcanic light,
Or hurl innocuous embers to the night.—

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*Alarm with comet-blaze.* l. 133. See additional notes, No. IV.

*The Sun's phlogiſtic orb.* l. 136. See additional notes, No. V.

*Round her ſtill centre.* l. 139. Many philoſophers have believed that the central parts of the earth conſiſt of a fluid maſs of burning lava, which they have called a ſubterraneous ſun; and have ſuppoſed that it contributes to the production of metals, and to the growth of vegetables. See additional notes, No. VI.

*Or ſphere on ſphere.* l. 143. See additional notes, No. VII.

*Hurl innocuous embers.* l. 152. The immediate cauſe of volcanic eruptions is believed to be owing to the water of the ſea, or from lakes or inundations, finding itſelf a paſſage into the ſubterraneous fires, which may lie at great depths. This muſt firſt produce, by its coldneſs, a condenſation of the vapour there exiſting, or a vacuum, and thus occaſion parts of the earth's cruſt or ſhell to be forced down by the preſſure of the incumbent atmoſphere. Afterwards the wate[illegible]nly raiſed into ſteam, produces all the exploſive effects of earthq[illegible], by new acceſſions of water, dur-

While with loud ſhouts to Etna Hecla calls,
And Andes anſwers from his beacon'd walls;
Sea-wilder'd crews the mountain-ſtars admire,
And beauty beams amid tremendous fire.

"Thus, when of old, as myſtic bards preſume,
Huge CYCLOPS dwelt in Etna's rocky womb,
On thundering anvils rung their loud alarms,
And leagu'd with VUCLAN forged immortal arms;
Deſcending VENUS ſought the dark abode,
And ſooth'd the labours of the griſly God.
While frowning Loves the threatening falchion wield,
And tittering Graces peep behind the ſhield,
With jointed mail their fairy limbs o'erwhelm,
Or nod with pauſing ſtep the plumed helm;
With radiant eye ſhe view'd the boiling ore,
Heard undiſmay'd the breathing bellows roar,
Admired their ſinewy arms, and ſhoulders bare,
And ponderous hammers lifted high in air,
With ſmiles celeſtial bleſs'd their dazzled ſight,
And Beauty blazed amid infernal night.

IV. *Effulgent Maids! you* round deciduous day,
Treſſed with ſoft beams, your glittering bands array;
On Earth's cold boſom, as the Sun retires,
Confine with folds of air the lingering fires;

ing the intervals of the exploſions, the repetition of the ſhocks is cauſed. Theſe circumſtances were hourly illuſtrated by the fountains of boiling water in Iceland, in which the ſurface of the water in the boiling wells ſunk down low before every new ebullition.

Beſides theſe eruptions occaſioned by the ſteam of water, there ſeems to be a perpetual effuſion of other vapours, more noxious, and (as far as it is yet known) perhaps greatly more expanſile than water from the Volcanos in various parts of the world. As theſe Volcanos are ſuppoſed to be ſpiracula, or breathing holes to the great ſubterraneous fires, it is probable that the eſcape of elaſtic vapours from them is the cauſe that the earthquakes of modern days are of ſuch ſmall extent compared to thoſe of ancient times, of which veſtiges remain in every part of the world, and, on this account, may be ſaid not only to be innocuous, but uſeful.

*Confine with folds of air*, l. 176. The air, like all other bad conductors of electricity, is known to be a bad conductor of heat; and thence prevents the heat acquired from the ſun's rays by the earth's ſurface from being ſo ſoon diſſipated, in the ſame manner as a blanket, which may be conſidered

O'er Eve's pale forms diffuſe phoſphoric light,
And deck with lambent flames the ſhrine of Night.
So, warm'd and kindled by meridian ſkies,
And view'd in darkneſs with dilated eyes, 180
Bologna's chalks with faint ignition blaze,
Beccari's ſhells emit priſmatic rays.

as a ſponge filled with air, prevents the eſcape of heat from the perſon wrapped in it. This ſeems to be one cauſe of the great degree of cold on the tops of mountains, where the rarity of the air is greater, and it therefore becomes a better conductor both of heat and electricity. See note on Barometz, Vol. II. of this work.

There is, however, another cauſe to which the great coldneſs of mountains, and of the higher regions of the atmoſphere, is more immediately to be aſcribed, explained by Dr. Darwin in the Philoſ. Tranſ. Vol. LXXVIII. who has there proved, by experiments with the air-gun and air-pump, that when any portion of the atmoſphere becomes mechanically expanded, it abſorbs heat from the bodies in its vicinity. And as the air which creeps along the plains expands itſelf, by a part of the preſſure being taken off, when it aſcends the ſides of mountains, it, at the ſame time, attracts heat from the ſummits of thoſe mountains, or other bodies which happen to be immerſed in it, and thus produces cold. Hence he concludes, that the hot air at the bottom of the Andes becomes temperate by its own rareſaction when it aſcends to the city of Quito; and by its further rarefaction becomes cooled to the freezing point when it aſcends to the ſnowy regions on the ſummits of thoſe mountains. To this alſo he attributes the great degree of cold experienced by the aëronauts in their balloons; and which produces hail in ſummer at the height of only two or three miles in the atmoſphere.

*Diffuſe phoſphoric light.* l. 177. I have often been induced to believe, from obſervation, that the twilight of the evenings is lighter than that of the mornings at the ſame diſtance from noon. Some may aſcribe this to the greater height of the atmoſphere in the evenings, having been rarefied by the ſun during the day; but as its denſity muſt at the ſame time be diminiſhed, its power of refraction would continue the ſame. I ſhould rather ſuppoſe that it may be owing to the phoſphoreſcent quality (as it is called) of almoſt all bodies; that is, when they have been expoſed to the ſun, they continue to emit light for a conſiderable time afterwards. This is generally believed to ariſe either from ſuch bodies giving out the light which they had previouſly abſorbed, or to the continuance of a ſlow combuſtion which the light they had been previouſly expoſed to had excited. See the next note.

*Beccari's ſhells.* l. 182. Beccari made many curious experiments on the phoſphoric light, as it is called, which becomes viſible on bodies brought into a dark room, after having been previouſly expoſed to the ſunſhine. It appears, from theſe experiments, that almoſt all inflammable bodies poſſeſs this quality in a greater or leſs degree; white paper or linen, thus examined, after having been expoſed to the ſunſhine, is luminous to an extraordinary degree. And if a perſon, ſhut up in a dark room, puts one of his hands out into the ſun's light for a ſhort time, and then retracts it, he will be able to ſee that hand diſtinctly, and not the other. Theſe experiments ſeem to countenance the idea of light being abſorbed, and again emitted from bodies when they are removed into darkneſs. But Beccari further pretended, that

So to the ſacred Sun in MEMNON's fane,
Spontaneous concords quired the matin ſtrain;
—Touch'd by his orient beam, reſponſive rings
The living lyre, and vibrates all its ſtrings;
Accordant ailes the tender tones prolong,
And holy echoes ſwell the adoring ſong.

" *You* with light Gas the lamps nocturnal feed,
Which dance and glimmer o'er the marſhy mead;
Shine round Calendula at twilight hours,
And tip with ſilver all her ſaffron flowers;
Warm on her moſſy couch the radiant Worm,
Guard from cold dews her love-illumin'd form,

ſome calcareous compoſitions, when expoſed to red, yellow, or blue lights, through coloured glaſſes, would, on their being brought into a dark room, emit coloured lights. This miſtaken fact of Beccari's, Mr. Wilſon decidedly refutes; and, among many other curious experiments, diſcovered, that if oyſter-ſhells were thrown into a common fire, and calcined for about half an hour, and then brought to a perſon who had previouſly been ſome minutes in a dark room, that many of them would exhibit beautiful iriſes of priſmatic colours, from whence, probably, aroſe Beccari's miſtake. Mr. Wilſon from hence contends, that theſe kinds of phoſphori do not emit the light they had previouſly received, but that they are ſet on fire by the ſun's rays, and continue for ſome time a ſlow combuſtion after they are withdrawn from the light. Wilſon's Experiments on Phoſphori. Dodſley, 1775.

The Bolognian ſtone is a ſelenite, or gypſum, and has been long celebrated for its phoſphoreſcent quality after having been burnt in a ſulphurous fire; and expoſed, when cold, to the ſun's light. It may be thus well imitated: Calcine oyſter-ſhells half an hour, pulverize them when cold, and add one third part of flowers of ſulphur, preſs them cloſe into a ſmall crucible, and calcine them for an hour or longer, and keep the po[illegible]r in a phial cloſe ſtopped. A part of this powder is to be expoſed for [illegible]e or two to the ſunbeams, and then brought into a dark room. [illegible]e cal[illegible]ed Bolognian ſtone becomes a calcareous hepar of ſulphur; but the calcined ſhells, as they contain the animal acid, may alſo contain ſome of the phoſphorus of Kunkel.

*In Memnon's fane.* l. 183. See additional notes, No. VIII.

*The lamps nocturnal.* l. 189. The ignis fatuus, or Jack a lantern, ſo frequently alluded to by poets, is ſuppoſed to originate from the inflammable air, or Hydrogene, given up from moraſſes; which being of a heavier kind, from its impurity, than that obtained from iron and water, hovers near the ſurface of the earth, and, uniting with common air, gives out light by its ſlow ignition. Perhaps ſuch lights have no exiſtence; and the reflection of a ſtar on watery ground may have deceived the travellers, who have been ſaid to be bewildered by them: if the fact was eſtabliſhed, it would much contribute to explain the phenomena of northern lights. I have travelled much in the night, in all ſeaſons of the year, and over all kinds of ſoil, but never ſaw one of theſe Will o'wiſps.

*Shine round Calendula.* l. 191. See note on Tropæolum in Vol. II.

*The radiant Worm.* l. 193. See additional notes, No. IX.

From leaf to leaf conduct the virgin light,
Star of the earth, and diamond of the night.
*You* bid in air the tropic Beetle burn,
And fill with golden flame his winged urn:
Or gild the ſurge with inſect-ſparks, that ſwarm
Round the bright oar, the kindling prow alarm;
Or arm in waves, electric in his ire,
The dread Gymnotus with ethereal fire.—

*The dread Gymnotus.* l. 202. The Gymnotus electricus is a native of the river of Surinam, in South-America; thoſe which were brought over to England about eight years ago were about three or four feet long, and gave an electric ſhock (as I experienced) by putting one finger on the back, near its head, and another of the oppoſite hand into the water near its tail. In their native country they are ſaid to exceed twenty feet in length, and kill any man who approaches them in an hoſtile manner. It is not only to eſcape its enemies that this ſurprizing power of the fiſh is uſed, but alſo to take its prey; which it does by benumbing them, and then devouring them before they have time to recover, or by perfectly killing them; for the quantity of the power ſeemed to be determined by the will or anger of the animal; as it ſometimes ſtruck a fiſh twice before it was ſufficiently benumbed to be eaſily ſwallowed.

The organs productive of this wonderful accumulation of electric matter have been accurately diſſected and deſcribed by Mr. J. Hunter. Philoſ. Tranſ. Vol. LXV. And are ſo divided by membranes as to compoſe a very extenſive ſurface, and are ſupplied with many pairs of nerves larger than any other nerves of the body: but how ſo large a quantity is ſo quickly accumulated as to produce ſuch amazing effects in a fluid ill adapted for the purpoſe, is not yet ſatisfactorily explained. The Torpedo poſſeſſes a ſimilar power in a leſs degree, as was ſhewn by Mr. Walch, and another fiſh lately deſcribed by Mr. Paterſon. Philoſ. Tranſ. Vol. LXXVI.

In the conſtruction of the Leyden-Phial, (as it is called) which is coated on both ſides, it is known, that above one hundred times the quantity of poſitive electricity can be condenſed on every ſquare inch of the coating on one ſide, than could have been accumulated on the ſame ſurface if there had been no oppoſite coating communicating with the earth; becauſe the negative electricity, or that part of it which cauſed its expanſion, is now drawn off through the glaſs. It is alſo well known, that the thinner the glaſs is (which is thus coated on both ſides ſo as to make a Leyden-Phial, or plate) the more electricity can be condenſed on one of its ſurfaces, till it becomes ſo thin as to break, and thence diſcharge itſelf.

Now, it is poſſible that the quantity of electricity condenſible on one ſide of a coated phial may increaſe in ſome high ratio in reſpect to the thinneſs of the glaſs, ſince the power of attraction is known to decreaſe as the ſquares of the diſtances, to which this circumſtance of electricity ſeems to bear ſome analogy. Hence, if an animal membrane, as thin as the ſilk-worm ſpins its ſilk, could be ſo ſituated as to be charged like the Leyden bottle, without burſting, (as ſuch thin glaſs would be liable to do,) it would be difficult to calculate the immenſe quantity of electric fluid which might be accumulated on its ſurface. No land animals are yet diſcovered which poſſeſs this power, though the air would have been a much better medium for pro-

Onward his courſe with waving tail he helms,
And mimic lightnings ſcare the watery realms;
So, when with briſtling plumes the bird of Jove
Vindictive leaves the argent fields above,
Borne on broad wings the guilty world he awes,
And graſps the lightning in his ſhining claws.

V. 1. "*Nymphs! your* ſoft ſmiles uncultur'd man ſubdued,
And charm'd the Savage from his native wood;
*You*, while amazed his hurrying Hords retire
From the fell havoc of devouring *Fire*,
Taught the firſt Art! with piny rods to raiſe,
By quick attrition the domeſtic blaze,
Fan with ſoft breath, with kindling leaves provide,
And liſt the dread deſtroyer on his ſide.

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ducing its effects; perhaps the ſize of the neceſſary apparatus would have been inconvenient to land animals.

*In his ſhining claws.* l. 208. Alluding to an antique gem in the collection of the Grand Duke of Florence. Spence.

*Of devouring Fire.* l. 212. The firſt and moſt important diſcovery of mankind ſeems to have been that of fire. For many ages, it is probable, fire was eſteemed a dangerous enemy, known only by its dreadful devaſtations; and that many lives muſt have been loſt, and many dangerous burns and wounds muſt have afflicted thoſe who firſt dared to ſubject it to the uſes of life. It is ſaid that the tall monkies of Borneo and Sumatra lie down with pleaſure round any accidental fire in their woods; and are arrived to that degree of reaſon, that knowledge of cauſation, that they thruſt into the remaining fire the half-burnt ends of the branches to prevent its going out.—One of the nobles of the cultivated people of Otaheite, when Captain Cook treated them with tea, catched the boiling water in his hand from the cock of the tea-urn, and bellowed with pain, not conceiving that water could become hot, like red fire.

Tools of ſteel conſtitute another important diſcovery in conſequence of fire; and contributed, perhaps, principally to give the European nations ſo great ſuperiority over the American world. By theſe two agents, fire and tools of ſteel, mankind became able to cope with the vegetable kingdom, and conquer provinces of foreſts, which, in uncultivated countries, almoſt exclude the growth of other vegetables, and of thoſe animals which are neceſſary to our exiſtence. Add to this, that the quantity of our food is alſo increaſed by the uſe of fire, for ſome vegetables become ſalutary food by means of the heat uſed in cookery, which are naturally either noxious or difficult of digeſtion; as potatoes, kidney-beans, onions, cabbages. The caſſava, when made into bread, is, perhaps, rendered mild by the heat it undergoes, more than by expreſſing its ſuperfluous juice. The roots of white bryony and of arum, I am informed, loſe much of their acrimony by boiling.

So, with bright wreath of ſerpent-treſſes crown'd,
Severe in beauty, young Medusa frown'd:
Erewhile ſubdued, round *Wiſdom*'s Ægis roll'd,
Hiſs'd the dread ſnakes, and flam'd in burniſh'd gold; 220
Flaſh'd on her brandiſh'd arm the immortal ſhield,
And terror lighten'd o'er the dazzled field.

2. *Nymphs! you* disjoin, unite, condenſe, expand,
And give new wonders to the Chemiſt's hand;
On tepid clouds of riſing ſteam aſpire, 225
Or fix in ſulphur all its ſolid fire;
With boundleſs ſpring elaſtic airs unfold,
Or fill the fine vacuities of gold;

*Young Meduſa frown'd.* l. 218. The Egyptian Meduſa is repreſented on ancient gems, with wings on her head, ſnaky hair, and a beautiful countenance, which appears intenſely thinking; and was ſuppoſed to repreſent divine wiſdom. The Grecian Meduſa, on Minerva's ſhield, as appears on other gems, has a countenance diſtorted with rage or pain, and is ſuppoſed to repreſent divine vengeance. This Meduſa was one of the Gorgons, at firſt very beautiful, and terrible to her enemies. Minerva turned her hair into ſnakes; and Perſeus having cut off her head, fixed it on the ſhield of that goddeſs; the ſight of which then petrified the beholders. Dannet. Dict.

*Or fix in ſulphur.* l. 226. The phenomena of chemical exploſions cannot be accounted for without the ſuppoſition, that ſome of the bodies employed contain concentrated or ſolid heat combined with them, to which the French chemiſts have given the name of Calorique. When air is expanded in the air-pump, or water evaporated into ſteam, they drink up or abſorb a great quantity of heat; from this analogy, when gun-powder is exploded, it ought to abſorb much heat; that is, in popular language, it ought to produce a great quantity of cold. When vital air is united with phlogiſtic matter in reſpiration, which ſeems to be a ſlow combuſtion, its volume is leſſened; the carbonic acid, and perhaps phoſphoric acid, are produced; and heat is given out; which, according to the experiments of Dr. Crawford, would ſeem to be depoſited from the vital air. But as the vital air in nitrous acid is condenſed from a light elaſtic gas to that of a heavy fluid, it muſt poſſeſs leſs heat than before. And hence a great part of the heat which is given out in firing gun-powder, I ſhould ſuppoſe, muſt reſide in the ſulphur or charcoal.

Mr. Lavoiſier has ſhewn, that vital air, or Oxygene, loſes leſs of its heat when it becomes one of the component parts of nitrous acid, than in any other of its combinations; and is hence capable of giving out a great quantity of heat in the exploſion of gun-powder; but as there ſeems to be great analogy between the matter of heat, or Calorique, and the electric matter; and as the worſt conductors of electricity are believed to contain the greateſt quantity of that fluid; there is reaſon to ſuſpect, that the worſt conductors of heat may contain the moſt of that fluid; as ſulphur, wax, ſilk, air, glaſs. See note on l. 174 of this Canto.

With ſudden flaſh vitreſcent ſparks reveal,
By fierce colliſion from the flint and ſteel;
Or mark with ſhining letters KUNKEL's name
In the pale Phoſphor's ſelf-conſuming flame.
So the chaſte heart of ſome enchanted Maid
Shines with inſidious light, by Love betrayed;
Round her pale boſom plays the young Deſire,
And ſlow ſhe waſtes by ſelf-conſuming fire.

3. "*You* taught myſterious BACON to explore
Metallic veins, and part the droſs from ore;
With ſylvan coal in whirling mills combine
The cryſtal'd nitre, and the ſulphurous mine;
Through wiry nets the black diffuſion ſtrain,
And cloſe an airy ocean in a grain.—

*Vitreſcent ſparks.* l. 229. When flints are ſtruck againſt other flints they have the property of giving ſparks of light; but it ſeems to be an internal light, perhaps of electric origin, very different from the ignited ſparks which are ſtruck from flint and ſteel. The ſparks produced by the colliſion of ſteel with flint, appear to be globular particles of iron, which have been fuſed, and imperfectly ſcorified or vitrified. They are kindled by the heat produced by the colliſion; but their vivid light, and their fuſion and vitrification are the effects of a combuſtion continued in theſe particles during their paſſage through the air. This opinion is confirmed by an experiment of Mr. Hawkſbee, who found that theſe ſparks could not be produced in the exhauſted receiver. See Keir's Chemical Dict. art. Iron, and art. Earth vitrifiable.

*The pale Phoſphor.* l. 232. See additional notes, No. X.

*And cloſe an airy ocean.* l. 242. Gun-powder is plainly deſcribed in the works of Roger Bacon, before the year 1267. He deſcribes it in a curious manner, mentioning the ſulphur and nitre, but conceals the charcoal in an anagram. The words are, ſed tamen ſalis petræ *lure mope can ubre*, et ſulphuris; et ſic facies tonitrum, et corruſcationem, ſi ſcias, artificium. The words lure mope can ubre are an anagram of carbonum pulvere. Biograph. Britan. Vol. I. Bacon de Secretis Operibus, Cap. XI. He adds, that he thinks, by an artifice of this kind, Gideon defeated the Midianites with only three hundred men. Judges, Chap. VII. Chamb. Dict. art. Gun-powder. As Bacon does not claim this as his own invention, it is thought, by many, to have been of much more ancient diſcovery.

The permanently elaſtic fluid, generated in the firing of gun-powder, is calculated by Mr. Robins to be about 244 if the bulk of the powder be 1. And that the heat generated at the time of the exploſion occaſions the rarefied air, thus produced, to occupy about 1000 times the ſpace of the gun-powder. This preſſure may therefore be called equal to 1000 atmoſpheres, or ſix tons upon a ſquare inch. As the ſuddenneſs of this exploſion muſt contribute much to its power, it would ſeem that the chamber of powder, to produce its greateſt effect, ſhould be lighted in the centre of it; which, I believe, is not attended to in the manufacture of muſkets or piſtols.

Pent in dark chambers of cylindric braſs,
Slumbers in grim repoſe the ſooty maſs;
Lit by the brilliant ſpark, from grain to grain
Runs the quick fire along the kindling train;
On the pain'd ear-drum burſts the ſudden craſh,
Starts the red flame, and Death purſues the flaſh.—
Fear's feeble hand directs the fiery darts,
And ſtrength and courage yield to chemic arts;
Guilt with pale brow the mimic thunder owns,
And Tyrants tremble on their blood-ſtain'd thrones.

VI. *Nymphs! you* erewhile on ſimmering cauldrons play'd,
And call'd delighted *Savery* to your aid;

From the cheapneſs with which a very powerful gun-powder is likely ſoon to be manufactured from aërated marine acid, or from a new method of forming nitrous acid by means of mangane̛ſe or other calciform ores, it may probably, in time, be applied to move machinery, and ſuperſede the uſe of ſteam.

There is a bitter invective in Don Quixote againſt the inventors of gun-powder, as it levels the ſtrong with the weak, the knight caſed in ſteel with the naked ſhepherd, thoſe who have been trained to the ſword with thoſe who are totally unſkilful in the uſe of it; and throws down all the ſplendid diſtinctions of mankind. Theſe very reaſons ought to have been urged to ſhew that the diſcovery of gun-powder as been of public utility, by weakening the tyranny of the few over the many.

*Delighted Savery*. l. 254. The invention of the ſteam-engine for raiſing water by the preſſure of the air, in conſequence of the condenſation of ſteam, is properly aſcribed to Capt. Savery; a plate and deſcription of this machine is given in Harris's Lexicon Technicum, art. Engine. Though the Marquis of Worceſter, in his Century of Inventions, printed in the year 1663, had deſcribed an engine for raiſing water by the exploſive power of ſteam long before Savery's. Mr. Deſaguliers affirms, that Savery bought up all he could procure of the books of the Marquis of Worceſter, and deſtroyed them, profeſſing himſelf then to have diſcovered the power of ſteam by accident, which ſeems to have been an unfounded ſlander. Savery applied it to the raiſing of water to ſupply houſes and gardens, but could not accompliſh the draining of mines by it. Which was afterwards done by Mr. Newcomen and Mr. John Cowley, at Dartmouth, in the year 1712, who added the piſton.

A few years ago Mr. Watt, of Glaſgow, much improved this machine, and with Mr. Boulton, of Birmingham, has applied it to variety of purpoſes, ſuch as raiſing water from mines, blowing bellows to fuſe the ore, ſupplying towns with water, grinding corn, and many other purpoſes. There is reaſon to believe it may in time be applied to the rowing of barges, and the moving of carriages along the road. As the ſpecific levity of air is too great for the ſupport of great burthens by balloons, there ſeems no probable method of flying conveniently but by the power of ſteam, or ſome other exploſive material; which another half century may probably diſcover. See additional notes, No. XI.

Bade round the youth exploſive *Steam* aſpire
In gathering clouds, and wing'd the wave with fire;
Bade with cold ſtreams the quick expanſion ſtop,
And ſunk the immenſe of vapour to a drop.—
Preſs'd by the ponderous air the Piſton falls
Reſiſtleſs, ſliding through its iron walls;
Quick moves the balanced beam of giant-birth,
Wields his large limbs, and, nodding, ſhakes the earth.

"The Giant-Power from earth's remoteſt caves
Lifts with ſtrong arm her dark reluctant waves;
Each cavern'd rock, and hidden den explores,
Drags her dark coals, and digs her ſhining ores.—
Next, in cloſe cells of ribbed oak confin'd,
Gale after gale, He crouds the ſtruggling wind;
The impriſon'd ſtorms through brazen noſtrils roar,
Fan the white flame, and fuſe the ſparkling ore.
Here high in air the riſing ſtream He pours
To clay-built ciſterns, or to lead-lined towers;
Freſh through a thouſand pipes the wave diſtils,
And thirſty cities drink the exuberant rills.—
There the vaſt mill-ſtone, with inebriate whirl,
On trembling floors his forceful fingers twirl.
Whoſe flinty teeth the golden harveſts grind,
Feaſt without blood! and nouriſh human-kind.

*Feaſt without blood!* l. 278. The benevolence of the great Author of all things is greatly manifeſt in the ſum of his works, as Dr. Balguy has well evinced in his pamphlet on Divine Benevolence aſſerted, printed for Davis, 1781. Yet, if we may compare the parts of nature with each other, there are ſome circumſtances of her economy which ſeem to contribute more to the general ſcale of happineſs than others. Thus the nouriſhment of animal bodies is derived from three ſources: 1. The milk given from the mother to the offspring: in this excellent contrivance the mother has pleaſure in affording the ſuſtenance to the child, and the child has pleaſure in receiving it. 2. Another ſource of the food of animals includes ſeeds, or eggs: in theſe the embryon is in a torpid or inſenſible ſtate, and there is along with it, laid up for its early nouriſhment, a ſtore of proviſion, as the fruit belonging to ſome ſeeds, and the oil and ſtarch belonging to others; when theſe are conſumed by animals, the unfeeling ſeed, or egg, receives no pain, but the animal receives pleaſure which conſumes it. Under this article may be included the bodies of animals which die naturally. 3. But the laſt method of ſupporting animal bodies by the deſtruction of other living animals, as lions preying upon lambs, theſe upon living vegetables, and

"Now his hard hands on Mona's rifted creſt,
Boſom'd in rock, her azure ores arreſt; 280
With iron lips his rapid rollers ſeize
The lengthening bars, in thin expanſion ſqueeze;
Deſcending ſcrews with ponderous fly-wheels wound
The tawny plates, the new medallions round;
Hard dyes of ſteel the cupreous circles cramp, 285
And with quick fall his maſſy hammers ſtamp.
The Harp, the Lily and the Lion join,
And George and Britain guard the ſterling coin.

"Soon ſhall thy arm, *Unconquer'd Steam!* afar
Drag the ſlow barge, or drive the rapid car; 290
Or on wide-waving wings expanded bear
The flying-chariot through the fields of air.
—Fair crews triumphant, leaning from above,
Shall wave their fluttering kerchiefs as they move;
Or warrior-bands alarm the gaping croud, 295
And armies ſhrink beneath the ſhadowy cloud.

"So mighty Hercules o'er many a clime
Waved his vaſt mace in Virtue's cauſe ſublime,

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mankind upon them all, would appear to be a leſs perfect part of the economy of nature than thoſe before mentioned, as contributing leſs to the ſum of general happineſs.

*Mona's rifted creſt.* l. 279. Alluding to the very valuable copper-mines in the iſle of Angleſey, the property of the Earl of Uxbridge.

*With iron lips.* l. 281. Mr. Boulton has lately conſtructed at Soho, near Birmingham, a moſt magnificent apparatus for Coining, which has coſt him ſome thouſand pounds; the whole machinery is moved by an improved ſteam-engine, which rolls the copper for half-pence finer than copper has before been rolled for the purpoſe of making money;—it works the coupoirs, or ſcrew-preſſes for cutting out the circular pieces of copper, and coins both the faces and edges of the money, at the ſame time, with ſuch ſuperior excellence, and cheapneſs of workmanſhip, as well as with marks of ſuch powerful machinery, as muſt totally prevent clandeſtine imitation, and, in conſequence, ſave many lives from the hand of the executioner; a circumſtance worthy the attention of a great miniſter. If a civic crown was given in Rome for preſerving the life of one citizen, Mr. Boulton ſhould be covered with garlands of oak! By this machinery four boys, of ten or twelve years old, are capable of ſtriking thirty thouſand guineas in an hour, and the machine itſelf keeps an unerring account of the pieces ſtruck.

*So mighty Hercules.* l. 297. The ſtory of Hercules ſeems of great antiquity, as appears from the ſimplicity of his dreſs and armour, a lion's ſkin

Unmeaſured ſtrength with early art combined,
Awed, ſerved, protected, and amazed mankind.—
Firſt two dread Snakes, at JUNO's vengeful nod,
Climb'd round the cradle of the ſleeping God;
Waked by the ſhrilling hiſs and ruſtling ſound,
And ſhrieks of fair attendants trembling round,
Their gaſping throats with clenching hands he holds;
And Death untwiſts their convoluted folds.
Next in red torrents from her ſevenfold heads
Fell HYDRA's blood on Lerna's lake he ſheds;
Graſps ACHELOUS with reſiſtleſs force,
And drags the roaring River to his courſe;
Binds with loud bellowing and with hideous yell,
The monſter Bull, and threefold Dog of Hell.

"Then where Nemea's howling foreſts wave,
He drives the Lion to his duſky cave;

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and a club; and from the nature of many of his exploits, the deſtruction of wild beaſts and robbers. This part of the hiſtory of Hercules ſeems to have related to times before the invention of the bow and arrow, or of ſpinning flax. Other ſtories of Hercules are perhaps of later date, and appear to be allegorical, as his conquering the river-god Achelous, and bringing Cerberus up to day-light; the former might refer to his turning the courſe of a river, and draining a moraſs, and the latter to his expoſing a part of the ſuperſtition of the times. The ſtrangling the lion, and tearing his jaws aſunder, are deſcribed from a ſtatue in the Muſeum Florentinum, and from an antique gem; and the graſping Anteus to death in his arms, as he lifts him from the earth, is deſcribed from another ancient cameo. The famous pillars of Hercules have been variouſly explained. Pliny aſſerts that the natives of Spain and of Africa believed that the mountains of Abyla and Calpè, on each ſide of the ſtraits of Gibraltar, were the pillars of Hercules; and that they were reared by the hands of that god, and the ſea admitted between them. Plin. Hiſt. Nat. p. 46. Edit. Manut. Venet. 1609.

If the paſſage between the two continents was opened by an earthquake in ancient times, as this allegorical ſtory would ſeem to countenance, there muſt have been an immenſe current of water at firſt run into the Mediterranean from the Atlantic; ſince there is at preſent a ſtrong ſtream ſets always from thence into the Mediterranean. Whatever may be the cauſe, which now conſtantly operates, ſo as to make the ſurface of the Mediterranean lower than that of the Atlantic, it muſt have kept it very much lower before a paſſage for the water through the ſtraits was opened. It is probable, before ſuch an event took place, the coaſts and iſlands of the Mediterranean extended much further into that ſea, and were then, for a great extent of country, deſtroyed by the floods occaſioned by the new riſe of water, and have ſince remained beneath the ſea. Might not this give riſe to the flood of Deucalion? See note Caſſia, Vol. II. of this work.

Seized by the throat, the growling fiend diſarms, 315
And tears his gaping jaws with ſinewy arms;
Lifts proud ANTÆUS from his mother-plains,
And with ſtrong graſp the ſtruggling Giant ſtrains;
Back falls his fainting head, and clammy hair,
Writhe his weak limbs, and flits his life in air;— 320
By ſteps reverted, o'er the blood-drop'd fen
He tracks huge CACUS to his murderous den;
Where breathing flames through brazen lips he fled,
And ſhakes the rock-roof'd cavern o'er his head.

"Laſt with wide arms the ſolid earth He tears, 325
Piles rock on rock, on mountain mountain rears;
Heaves up huge *Abyla* on Afric's ſand,
Crowns with high *Calpè* Europe's ſalient ſtrand;
Creſts with oppoſing towers the ſplendid ſcene,
And pours from urns immenſe the ſea between.— 330
—Loud o'er her whirling flood Charybdis roars,
Affrighted Scylla bellows round his ſhores;
Veſuvio groans through all his echoing caves,
And Etna thunders o'er the inſurgent waves.

VII. 1. *Nymphs! your* fine hands ethereal floods amaſs
From the warm cuſhion, and the whirling glaſs; 336
Beard the bright cylinder with golden wire,
And circumfuſe the gravitating fire.
Cold from each point cerulean luſtres gleam,
Or ſhoot in air the ſcintillating ſtream. 340

*Ethereal floods amaſs.* l. 335. The theory of the accumulation of the electric fluid, by means of the glaſs globe and cuſhion, is difficult to comprehend. Dr. Franklin's idea of the pores of the glaſs being opened by the friction, and thence rendered capable of attracting more electric fluid, which it again parts with, as the pores contract again, ſeems analogous, in ſome meaſure, to the heat produced by the vibration, or condenſation of bodies, as when a nail is hammered or filed till it becomes hot, as mentioned in additional notes, No. VII. Some philoſophers have endeavoured to account for this phenomenon, by ſuppoſing the exiſtence of two electric fluids, which may be called the vitreous and reſinous ones, inſtead of the plus and minus of the ſame ether. But its accumulation on the rubbed glaſs bears great analogy to its accumulation on the ſurface of the Leyden bottle, and cannot, perhaps, be explained from any known mechanical or chemical principle. See note on Gymnotus, l. 202 of this Canto.

*Cold from each point.* l. 339. See additional notes, No. XIII.

So, borne on brazen talons, watch'd of old
The ſleepleſs dragon o'er his fruits of gold;
Bright beam'd his ſcales, his eye-balls blazed with ire,
And his wide noſtrils breath'd inchanted fire.

"*You* bid gold-leaves, in cryſtal lantherns held,
Approach attracted, and recede repell'd;
While paper-nymphs inſtinct with motion riſe,
And dancing fauns the admiring Sage ſurprize.
*Or*, if on wax ſome fearleſs Beauty ſtand,
And touch the ſparkling rod with graceful hand;
Through her fine limbs the mimic lightnings dart,
And flames innocuous eddy round her heart:
O'er her fair brow the kindling luſtres glare,
Blue rays diverging from the briſtling hair;
While ſome fond youth the kiſs ethereal ſips,
And ſoft fires iſſue from their meeting lips.
So round the virgin Saint in ſilver ſtreams
The holy Halo ſhoots its arrowy beams.

"*You* croud in coated jars the denſer fire,
Pierce the thin glaſs, and fuſe the blazing wire;

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*You bid gold-leaves.* l. 345. Alluding to the very ſenſible electrometer improved by Mr. Bennett: it conſiſts of two ſlips of gold-leaf ſuſpended from a tin cap in a glaſs cylinder, which has a partial coating without, communicating with the wooden pedeſtal. If a ſtick of ſealing-wax be rubbed for a moment on a dry cloth, and then held in the air, *at the diſtance of two or three feet* from the cap of this inſtrument, the gold leaves ſeparate, ſuch is its aſtoniſhing ſenſibility to electric influence! (See Bennett on electricity. Johnſon. Lond.) The nerves of ſenſe of animal bodies do not ſeem to be affected by leſs quantities of light or heat.

*The holy Halo.* l. 358. I believe it is not known with certainty at what time the painters firſt introduced the luminous circle round the head, to import a Saint or holy perſon. It is now become a part of the ſymbolic language of painting, and it is much to be wiſhed that this kind of hieroglyphic character was more frequent in that art, as it is much wanted to render hiſtoric pictures both more intelligible and more ſublime; and why ſhould not painting, as well as poetry, expreſs itſelf in metaphor, or in diſtinct allegory? A truly great modern painter lately endeavoured to enlarge the ſphere of pictorial language, by putting a demon behind the pillow of a wicked man on his death-bed. Which, unfortunately for the ſcientific part of painting, the cold criticiſm of the preſent day has depreciated, and thus barred, perhaps, the only road to the further improvement in this ſcience.

Or dart the red flaſh through the circling band
Of youths and timorous damſels, hand in hand.
—Starts the quick Ether through the fibre-trains
Of dancing arteries, and of tingling veins,
Goads each fine nerve, with new ſenſation thrill'd, 365
Bends the reluctant limbs with power unwill'd;
Palſy's cold hands the fierce concuſſion own,
And Life clings trembling on her tottering throne.—
So from dark clouds the playful lightning ſprings,
Rives the firm oak, or prints the Fairy-rings. 370

2. *Nymphs!* on that day *Ye* ſhed from lucid eyes
Celeſtial tears, and breathed ethereal ſighs!
When RICHMAN rear'd, by fearleſs haſte betray'd,
The wiry rod in Nieva's fatal ſhade;—

*With new ſenſation thrill'd.* l. 365. There is probably a ſyſtem [illegible] nerves in animal bodies for the purpoſe of perceiving heat; ſince the degree of this fluid is ſo neceſſary to health, that we become preſently injured, [illegible] by its exceſs or defect; and becauſe almoſt every part of our bodies [illegible] ſupplied with branches from different pairs of nerves, which would not [illegible] been neceſſary for their motion alone. It is therefore probable, that our ſenſation of electricity is only of its violence in paſſing through our ſyſtem [illegible] by its ſuddenly diſtending the muſcles, like any other mechanical violence; and that it is general pain alone that we feel, and not any ſenſation analogous to the ſpecific quality of the object. Nature may ſeem to have been niggardly to mankind in beſtowing upon them ſo few ſenſes; ſince a ſenſe to have perceived electricity, and another to have perceived magnetiſm, might have been of great ſervice to them, many ages before theſe fluids were diſcovered by accidental experiment; but it is poſſible an increaſed number of ſenſes might have incommoded us by adding to the ſize of our bodies.

*Palſy's cold hands.* l. 367. Paralytic limbs are in general only incapable of being ſtimulated into action by the power of the will; ſince the pulſe continues to beat, and the fluids to be abſorbed in them; and it commonly happens, when paralytic people yawn and ſtretch themſelves (which is not a voluntary motion,) that the affected limb moves at the ſame time. The temporary motion of a paralytic limb is likewiſe cauſed by paſſing the electric ſhock through it; which would ſeem to indicate ſome analogy between the electric fluid and the nervous fluid, which is ſeparated from the blood by the brain, and thence diffuſed along the nerves, for the purpoſes of motion and ſenſation. It probably deſtroys life, by its ſudden expanſion of the nerves, or fibres of the brain, in the ſame manner as it fuſes metals, and ſplinters wood or ſtone, and removes the atmoſphere when it paſſes from one object to another in a denſe ſtate.

*Prints the Fairy-rings.* l. 370. See additional notes, No. XIII.

*When Richman rear'd.* l. 373. Dr. Richman, Profeſſor of Natural Philoſophy at Peterſburgh, about the year 1763, elevated an inſulated metallic rod to collect the aërial electricity, as Dr. Franklin had previouſly done at

Clouds o'er the Sage, with fringed ſkirts ſucceed,
Flaſh follows flaſh, the warning corks recede;
Near and more near He ey'd, with fond amaze,
The ſilver ſtreams, and watch'd the ſapphire blaze;
Then burſts the ſteel, the dart electric ſped,
And the bold Sage lay number'd with the dead!
*Nymphs!* on that day *Ye* ſhed from lucid eyes
Celeſtial tears, and breathed ethereal ſighs!

3. "*You* led your FRANKLIN to your glaz'd retreats,
Your air-built caſtles, and your ſilken ſeats;
Bade his bold arm invade the lowering ſky,
And ſeize the tip-toe lightnings ere they fly;
O'er the young Sage your myſtic mantle ſpread,
And wreath'd the crown electric round his head.—
Thus, when on wanton wing intrepid *Love*
Snatch'd the rais'd lightning from the arm of JOVE;

Philadelphia; and as he was obſerving the repulſion of the balls of his electrometer, approached too near the conductor, and receiving the lightning in his head, with a loud exploſion, was ſtruck dead amidſt his family.

*You led your Franklin.* l. 383. Dr. Franklin was the firſt that diſcovered that lightning conſiſted of electric matter; he elevated a tall rod with a wire wrapped round it, and fixing the bottom of a rod into a glaſs bottle, and preſerving it from falling by means of ſilk ſtrings, he found it electrified whenever a cloud paſſed over it, receiving ſparks by his finger from it, and charging coated phials. This great diſcovery taught us to defend houſes, and ſhips, and temples, from lightning, and alſo to underſtand *that people are always perfectly ſafe in a room during a thunder-ſtorm, if they keep themſelves at three or four feet diſtance from the walls;* for the matter of lightning, in paſſing from the clouds to the earth, or from the earth to the clouds, runs through the walls of a houſe, the trunk of a tree, or other elevated object; except there be ſome moiſter body, as an animal, in contact with them, or nearly ſo; and in that caſe the lightning leaves the wall or tree, and paſſes through the animal; but as it can paſs through metals with ſtill greater facility, it will leave animal bodies to paſs through metallic ones.

If a perſon, in the open air, be ſurpriſed by a thunder-ſtorm, he will know his danger by obſerving, on a ſecond watch, the time which paſſes between the flaſh and crack, and reckoning a mile for every four ſeconds and a half, and a little more. For ſound travels at the rate of 1142 feet in a ſecond of time; and the velocity of light, through ſuch ſmall diſtances, is not to be eſtimated. In theſe circumſtances a perſon would be ſafer by lying down on the ground than erect, and ſtill ſafer if within a few feet of his horſe; which, being then a more elevated animal, will receive the ſhock in preference, as the cloud paſſes over. See additional notes, No. XIII.

*Intrepid Love.* l. 389. This allegory is uncommonly beautiful, repreſenting Divine Juſtice as diſarmed by Divine Love, and relenting of his purpoſe.

Quick o'er his knee the triple bolt He bent,
The cluſter'd darts and forky arrows rent,
Snapt with illumin'd hands each flaming ſhaft,
His tingling fingers ſhook, and ſtamp'd, and laugh'd;
Bright o'er the floor the ſcattered fragments blaz'd,
And Gods, retreating, trembled as they gaz'd;
The immortal Sire, indulgent to his child,
Bow'd his ambroſial locks, and Heaven, relenting, ſmiled.

VIII. “ When Air's pure eſſence joins the vital flood,
And with phoſphoric Acid dyes the blood,
*Your Virgin trains* the tranſient *heat* diſpart,
And lead the ſoft combuſtion round the heart;
Life's holy lamp with fires ſucceſſive feed,
From the crown'd forehead to the proſtrate weed,
From Earth's proud realms to all that ſwim or ſweep
The yielding ether or tumultuous deep.
*You* ſwell the bulb beneath the heaving lawn,
Brood the live ſeed, unfold the burſting ſpawn;

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It is expreſſed on an agate in the Great Duke's collection at Florence. Spence.

*Tranſient heat diſpart.* l. 401. Dr. Crawford, in his ingenious work on animal heat, has endeavoured to prove, that during the combination of the pure part of the atmoſphere with the phlogiſtic part of the blood, that much of the matter of the heat is given out from the air; and that this is the great and perpetual ſource of the heat of animals: to which we may add, that the phoſphoric acid is probably produced by this combination; by which acid the colour of the blood is changed in the lungs from a deep crimſon to a bright ſcarlet. There ſeems to be, however, another ſource of animal heat, though of a ſimilar nature; and that is from the chemical combinations produced in all the glands; ſince, by whatever cauſe any glandular ſecretion is increaſed, as by friction or topical inflammation, the heat of that part becomes increaſed at the ſame time; thus, after the hands have been for a time immerſed in ſnow, on coming into a warm room, they become red and hot, without any increaſed pulmonary action. BESIDES THIS, there would ſeem to be another material received from the air by reſpiration; which is ſo neceſſary to life, that the embryon muſt learn to breathe almoſt within a minute after its birth, or it dies. The perpetual neceſſity of breathing ſhews, that the material thus acquired is perpetually conſuming or eſcaping, and, on that account, requires perpetual renovation. Perhaps the ſpirit of animation itſelf is thus acquired from the atmoſphere, which, if it be ſuppoſed to be finer or more ſubtle than the electric matter, could not long be retained in our bodies, and muſt therefore require perpetual renovation.

Nurſe with ſoft lap, and warm with fragrant breath
The embryon panting in the arms of Death;
Youth's vivid eye with living light adorn,
And fire the riſing bluſh of Beauty's golden morn.

"Thus when the Egg of Night, on Chaos hurl'd,
Burſt, and diſcloſed the cradle of the world;
Firſt from the gaping ſhell refulgent ſprung
*Immortal Love*, his bow celeſtial ſtrung;—
O'er the wide waſte his gaudy wings unfold,
Beam his ſoft ſmiles, and wave his curls of gold;
With ſilver darts He pierced the kindling frame,
And lit with torch divine the ever-living flame."

IX. *The Goddeſs* pauſed, admired with conſcious pride
The effulgent legions marſhal'd by her ſide,
Forms, ſphered in fire, with trembling light array'd,
Ens without weight, and ſubſtance without ſhade;
And while tumultuous joy her boſom warms,
Waves her white hand, and calls her hoſts to arms.

"Unite, *illuſtrious Nymphs!* your radiant powers,
Call from their long repoſe the *Vernal Hours.*
Wake with ſoft touch, with roſy hands unbind
The ſtruggling pinions of the *weſtern Wind:*

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*Thus when the Egg of Night.* l. 413. There were two Cupids belonging to the ancient mythology, one much elder than the other. The elder Cupid, or Eros, or Divine Love, was the firſt that came out of the great egg of night, which floated in Chaos, and was broken by the horns of the celeſtial bull, that is, was hatched by the warmth of the ſpring. He was winged and armed, and by his arrows and torch pierced and vivified all things, producing life and joy. Bacon, vol. V. p. 197. Quarto edit. Lond. 1778. "At this time, (ſays Ariſtophanes,) ſable-winged night produced an egg, from whence ſprung up like a bloſſom Eros, the lovely, the deſirable, with his gloſſy golden wings." Avibus. Bryant's Mythology, vol. II. p. 350, ſecond edition. This intereſting moment of this ſublime allegory, Mrs. Coſway has choſen for her very beautiful painting. She has repreſented Eros, or Divine Love, with large wings, having the ſtrength of the eagle's wings, and the ſplendour of the peacock's, with his hair floating in the form of flame, and with a halo of light vapour round his head, which illuminates the painting, while he is in the act of ſpringing forwards, and with his hands ſeparating the elements.

*Of the weſtern Wind.* l. 430. The principal froſts of this country are accompanied or produced by a N. E. wind, and the thaws by a S. W. wind;

Chaſe his wan cheeks, his ruffled plumes repair,
And wring the rain-drops from his tangled hair.
Blaze round each froſted rill, or ſtagnant wave,
And charm the Naiad from her ſilent cave;
Where, ſhrined in ice, like Niobe ſhe mourns, 435
And claſps with hoary arms her empty urns.
Call your bright myriads, trooping from afar,
With beamy helms, and glittering ſhafts of war;
In phalanx firm, the *Fiend of Froſt* aſſail,
Break his white towers, and pierce his cryſtal mail; 440

the reaſon of which is, that the N. E. winds conſiſt of regions of air brought from the north, which appear to acquire an eaſterly direction as they advance; and the S. W. winds conſiſt of regions of air brought from the ſouth, which appear to acquire a weſterly direction as they advance. The ſurface of the earth nearer the pole moves ſlower than it does in our latitude; whence the regions of air brought from thence move ſlower, when they arrive hither, than the earth's ſurface, with which they now become in contact; that is, they acquire an apparent eaſterly direction, as the earth moves from weſt to eaſt faſter than this new part of its atmoſphere. The S. W. winds, on the contrary, conſiſt of regions of air brought from the ſouth, where the ſurface of the earth moves faſter than in our latitude; and have, therefore, a weſterly direction when they arrive hither, by their moving faſter than the ſurface of the earth, with which they are in contact; and, in general, the nearer to the weſt, and the greater the velocity of theſe winds, the warmer they ſhould be in reſpect to the ſeaſon of the year, ſince they have been brought more expeditiouſly from the ſouth than thoſe winds which have leſs weſterly direction, and have thence been leſs cooled in their paſſage.

Sometimes I have obſerved the thaw to commence immediately on the change of the wind, even within an hour, if I am not miſtaken, or ſooner. At other times, the S. W. wind has continued a day, or even two, before the thaw has commenced; during which time ſome of the froſty air, which had gone ſouthwards, is driven back over us; and, in conſequence, has taken a weſterly direction as well as a ſouthern one. At other times, I have obſerved a froſt, with a N. E. wind, every morning, and a thaw, with a S. W. wind, every noon, for ſeveral days together. See additional notes, No. XXXIII.

*The Fiend of Froſt.* l. 439. The principal injury done to vegetation by froſt, is from the expanſion of the water contained in the veſſels of plants. Water, converted into ice, occupies a greater ſpace than it did before, as appears by the burſting of bottles filled with water at the time of their freezing. Hence froſt deſtroys thoſe plants of our iſland firſt, which are moſt ſucculent; and the moſt ſucculent parts firſt of other plants, as their leaves and laſt year's ſhoots; the veſſels of which are diſtended and burſt by the expanſion of their freezing fluids; while the drier, or more reſinous plants, as pines, yews, laurels, and other ever-greens, are leſs liable to injury from cold. The trees in vallies are, on this account, more injured by the vernal froſts than thoſe on eminences, becauſe their early ſucculent ſhoots come out ſooner. Hence fruit trees, covered by a ſix-inch coping of a wall, are leſs injured by the vernal froſts, becauſe their being ſhielded from ſhowers

To Zembla's moon-bright coaſts the Tyrant bear,
And chain him, howling, to the Northern Bear.

"So when enormous Grampus, iſſuing forth
From the pale regions of the icy North,
Waves his broad tail, and opes his ribbed mouth,
And ſeeks on winnowing fin the breezy South;
From towns deſerted ruſh the breathleſs hoſts,
Swarm round the hills, and darken all the coaſts;
Boats follow boats along the ſhouting tides,
And ſpears and javelins pierce his blubbery ſides;
Now the bold Sailor, raiſed on pointed toe,
Whirls the wing'd harpoon on the ſlimy foe;
Quick ſinks the monſter in his oozy bed,
The blood-ſtain'd ſurges circling o'er his head,
Steers to the frozen pole his wonted track,
And bears the iron tempeſt on his back.

X. "On wings of flame *ethereal Virgins!* ſweep
O'er Earth's fair boſom, and complacent deep;
Where dwell my vegetative realms benumb'd,
In buds impriſon'd or in bulbs intomb'd.

and the deſcending night-dews, has prevented them from being moiſt at the time of their being frozen; which circumſtance has given occaſion to a vulgar error amongſt gardeners, who ſuppoſe froſt to deſcend.

As the common heat of the earth, in this climate, is 48 degrees, thoſe tender trees which will bear bending down, are eaſily ſecured from the froſt, by ſpreading them upon the ground, and covering them with ſtraw or fern. This particularly ſuits fig-trees, as they eaſily bear bending to the ground, and are furniſhed with an acrid juice, which ſecures them from the depredations of inſects, but are, nevertheleſs, liable to be eaten by mice. See additional notes, No. XII.

*In buds impriſon'd.* l. 460. The buds and bulbs of plants conſtitute what is termed by Linnæus the Hybernaculum, or winter cradle of the embryon vegetable. The buds ariſe from the bark on the branches of trees, and the bulbs from the caudex of bulbous-rooted plants, or the part from which the fibres of the root are produced: they are defended from too much moiſture, and from froſts, and from the depredations of inſects, by various contrivances, as by ſcales, hairs, reſinous varniſhes, and by acrid rinds.

The buds of trees are of two kinds, either flower-buds or leaf-buds; the former of theſe produce their ſeeds, and die; the latter produce other leaf-buds, or flower-buds, and die. So that all the buds of trees may be conſidered as annual plants, having their embryon produced during the preceding ſummer. The ſame ſeems to happen with reſpect to bulbs; thus a tulip produces annually one flower-bearing bulb, ſometimes two, and ſeveral leaf-

Pervade, *pellucid Forms!* their cold retreat,
Ray from bright urns your viewleſs floods of *heat*;
From Earth's deep waſtes *electric* torrents pour,
Or ſhed from heaven the ſcintillating ſhower;

bearing bulbs; and then the old root periſhes. Next year the flower-bearing bulb produces ſeeds and other bulbs, and periſhes; while the leaf-bearing bulb, producing other bulbs only, periſhes likewiſe: theſe circumſtances eſtabliſh a ſtrict analogy between bulbs and buds. See additional notes, No. XIV.

*Viewleſs floods of heat.* l. 462. The fluid matter of heat, or Calorique, in which all bodies are immerſed, is as neceſſary to vegetable as to animal exiſtence. It is not yet determinable whether heat and light be different materials, or modifications of the ſame materials, as they have ſome properties in common. They appear to be both of them equally neceſſary to vegetable health, ſince, without light, green vegetables become firſt yellow; that is, they loſe their blue colour, which contributed to produce the green; and afterwards they alſo loſe the yellow, and become white; as is ſeen in cellery blanched or etiolated for the table, by excluding the light from it.

The upper ſurface of leaves, which I ſuppoſe to be their organ of reſpiration, ſeems to require light as well as air; ſince plants which grow in windows, on the inſide of houſes, are equally ſolicitous to turn the upper ſide of their leaves to the light. Vegetables, at the ſame time, exſude or perſpire a great quantity from their leaves, as animals do from their lungs; this perſpirable matter, as it riſes from their fine veſſels, (perhaps much finer than the pores of animal ſkins,) is divided into inconceivable tenuity; and, when acted upon by the ſun's light, appears to be decompoſed; the hydrogene becomes a part of the vegetable, compoſing oils or reſins; and the oxygene, combined with light or calorique, aſcends, producing the pure part of the atmoſphere, or vital air. Hence, during the light of the day, vegetables give up more pure air than their reſpiration injures; but not ſo in the night, even though equally expoſed to warmth. This ſingle fact would ſeem to ſhew, that light is eſſentially different from heat; and it is, perhaps, by its combination with bodies, that their combined or latent heat is ſet at liberty, and becomes ſenſible. See additional notes, No. XXXIV.

*Electric torrents pour.* l. 463. The influence of electricity in forwarding the germination of plants, and their growth, ſeems to be pretty well eſtabliſhed, though Mr. Ingenhouz did not ſucceed in his experiments, and thence doubts the ſucceſs of thoſe of others; and though Mr. Rouland, from his new experiments, believes that neither poſitive nor negative electricity increaſes vegetation, both which philoſophers had previouſly been ſupporters of the contrary doctrine, for many other naturaliſts have ſince repeated their experiments relative to this object, and their new reſults have confirmed their former ones. Mr. D'Ormoy, and the two Roziers, have found the ſame ſucceſs in numerous experiments which they have made in the laſt two years; and Mr. Carmoy has ſhewn, in a convincing manner, that electricity accelerates germination.

Mr. D'Ormoy not only found various ſeeds to vegetate ſooner, and to grow taller, which were put upon his inſulated table, and ſupplied with electricity, but alſo, that ſilk-worms began to ſpin much ſooner which were kept electrified, than thoſe of the ſame hatch, which were kept in the ſame place and manner, except that they were not electrified. Theſe experiments of M. D'Ormoy are detailed at length in the Journal de Phyſique of Rozier, Tom. XXXV. p. 270.

Pierce the dull root, relax its fibre-trains, 465
Thaw the thick blood, which lingers in its veins;
Melt with warm breath the fragrant gums, that bind
The expanding foliage in its ſcaly rind;
And as in air the laughing leaflets play,
And turn their ſhining boſoms to the ray, 470
Nymphs! with ſweet ſmile, each opening flower invite,
And on its damaſk eyelids pour the *light*.

"So ſhall my pines, Canadian wilds that ſhade,
Where no bold ſtep has pierc'd the tangled glade,
High-towering palms, that part the Southern flood, 475
With ſhadowy iſles, and continents of wood,
Oaks, whoſe broad antlers creſt Britannia's plain,
Or bear her thunders o'er the conquer'd main,
Shout, as you paſs, inhale the genial ſkies,
And baſk and brighten in your beamy eyes; 480
Bow their white heads, admire the changing clime;
Shake from their candied trunks the tinkling rime;
With burſting buds their wrinkled barks adorn,
And wed the timorous floret to her thorn;
Deep ſtrike their roots, their lengthening tops revive, 485
And all my world of foliage wave, alive.

"Thus, with Hermetic art, the Adept combines
The royal acid with cobaltic mines;

---

M. Bartholon, who had before written a tract on this ſubject, and propoſed ingenious methods for applying electricity to agriculture and gardening, has alſo repeated a numerous ſet of experiments; and ſhews, both that natural electricity, as well as the artificial, increaſes the growth of plants, and the germination of ſeeds; and oppoſes Mr. Ingenhouz by very numerous and concluſive facts. Ib. Tom. XXXV. p. 401.

Since, by the late diſcoveries or opinions of the chemiſts, there is reaſon to believe, that water is decompoſed in the veſſels of vegetables; and that the Hydrogene, or inflammable air, of which it in part conſiſts, contributes to the nouriſhment of the plant, and to the production of its oils, reſins, gums, ſugar, &c. and, laſtly, as electricity decompoſes water into theſe two airs, termed Oxygene and Hydrogene, there is a powerful analogy to induce us to believe, that it accelerates or contributes to the growth of vegetation, and, like heat, may poſſibly enter into combination with many bodies, or form the baſis of ſome yet unanalized acid.

*Thus with Hermetic art.* l. 487. The ſympathetic inks made by Zaffre, diſſolved in the marine and nitrous acids, have this curious property, that,

Marks, with quick pen, in lines unſeen portrayed,
The bluſhing mead, green dell, and duſky glade;
Shades, with pellucid clouds, the tintleſs field,
And all the future Group exiſts conceal'd;
Till, waked by fire, the dawning tablet glows,
Green ſprings the herb, the purple floret blows;
Hills, vales, and woods, in bright ſucceſſion riſe,
And all the living landſcape charms his eyes.

XI. " With creſt of gold ſhould ſultry Sirius glare,
And with his kindling treſſes ſcorch the air;
With points of flame the ſhafts of Summer arm,
And burn the beauties he deſigns to warm:—
So erſt when Jove his oath extorted mourn'd,
And, clad in glory, to the Fair return'd;
While Loves at forky bolts their torches light,
And reſting lightnings gild the car of Night;
His blazing form the dazzled Maid admir'd,
Met with fond lips, and in his arms expir'd;—
*Nymphs!* on light pinion lead your banner'd hoſts
High o'er the cliffs of Orkney's gulphy coaſts;
Leave on your left the red volcanic light,
Which Hecla lifts amid the duſky night;
Mark, on the right, the *Dofrine*'s ſnow-capt brow,
Where whirling *Maelſtrome* roars and foams below;
Watch, with unmoving eye, where Cepheus bends
His triple crown, his ſcepter'd hand extends;

---

being brought to the fire, one of them becomes green, and the other red; but what is more wonderful, they again loſe theſe colours (unleſs the heat has been too great,) on their being again withdrawn from the fire. 'Fire-ſcreens have been thus painted, which, in the cold, have ſhewn only the trunk and branches of a dead tree, and ſandy hills, which, on their approach to the fire, have put forth green leaves and red flowers, and graſs upon the mountains. The proceſs of making theſe inks is very eaſy; take Zaffre, as ſold by the druggiſts, and digeſt it in aqua-regia, and the calx of Cobalt will be diſſolved; which ſolution muſt be diluted with a little common water, to prevent it from making too ſtrong an impreſſion on the paper; the colour, when the paper is heated, becomes of a fine green-blue. If Zaffre, or Regulus of Cobalt, be diſſolved in the ſame manner in ſpirit of nitre, or aqua-fortis, a reddiſh colour is produced on expoſing the paper to heat. Chemical Dictionary, by Mr. Keir, art. Ink Sympathetic.

Where ſtuds CASSIOPE, with ſtars unknown,
Her golden chair, and gems her ſapphire zone;
Where with vaſt convolution DRACO holds
The ecliptic axis in his ſcaly folds,
O'er half the ſkies his neck enormous rears,
And with immenſe meanders parts the BEARS;
Onward the kindred BEARS, with footſtep rude,
Dance round the pole, purſuing and purſued.

"There in her azure coif and ſtarry ſtole,
Grey *Twilight* ſits, and rules the ſlumbering Pole;
Bends the pale moon-beams round the ſparkling coaſt,
And ſtrews, with livid hands, eternal froſt.
There, *Nymphs!* alight, array your dazzling powers,
With ſudden march alarm the torpid Hours;
On ice-built iſles expand a thouſand ſails,
Hinge the ſtrong helms, and catch the frozen gales;

---

*With ſtars unknown.* l. 515. Alluding to the ſtar which appeared in the chair of Caſſiopea in the year 1572, which, at firſt, ſurpaſſed Jupiter in magnitude and brightneſs, diminiſhed by degrees, and diſappeared in 18 months; it alarmed all the aſtronomers of the age, and was eſteemed a comet by ſome.—Could this have been the Georgium Sidus?

*On ice-built iſles.* l. 529. There are many reaſons to believe, from the accounts of travellers and navigators, that the iſlands of ice in the higher northern latitudes, as well as the Glaciers on the Alps, continue perpetually to increaſe in bulk. At certain times in the ice-mountains of Switzerland, there happen cracks which have ſhown the great thickneſs of the ice, as ſome of theſe cracks have meaſured three or four hundred ells deep. The great iſlands of ice in the northern ſeas near Hudſon's bay, have been obſerved to have been immerſed above one hundred fathoms beneath the ſurface of the ſea, and to have riſen a fifth or ſixth part above the ſurface, and to have meaſured between three and four miles in circumference. Phil. Tranſ. No. 465. Sect. 2.

Dr. Liſter endeavoured to ſhew, that the ice of ſea-water contains ſome ſalt, and perhaps leſs air than common ice, and that it is, therefore, much more difficult of ſolution; whence he accounts for the perpetual and great increaſe of theſe floating iſlands of ice. Philoſ. Tranſ. No. 169.

As, by a famous experiment of Mr. Boyle's, it appears, that ice evaporates very faſt in ſevere froſty weather, when the wind blows upon it; and as ice, in a thawing ſtate, is known to contain ſix times more cold than water at the ſame degree of ſenſible coldneſs, it is eaſy to underſtand, that winds blowing over iſlands and continents of ice, perhaps much below nothing on Fahrenheit's ſcale, and coming from thence into our latitude, muſt bring great degrees of cold along with them. If we add to this the quantity of cold produced by the evaporation of the water, as well as by the ſolution of the ice, we cannot doubt but that the northern ice is the principal ſource of the coldneſs of our winters, and that it is brought hither by the regions of air blowing from the north, and which take an apparent

The winged rocks to feveriſh climates guide,
Where fainting Zephyrs pant upon the tide;
Paſs, where to CEUTA CALPE's thunder roars,
And anſwering echoes ſhake the kindred ſhores;
Paſs, where with palmy plumes CANARY ſmiles,
And in her ſilver girdle binds her iſles;
Onward, where *Niger*'s duſky Naiad laves
A thouſand kingdoms with prolific waves,
Or leads o'er golden ſands her threefold train
In ſteamy channels to the fervid main,
While ſwarthy nations croud the ſultry coaſt,
Drink the freſh breeze, and hail the floating Froſt,
*Nymphs!* veil'd in miſt, the melting treaſures ſteer,
And cool, with arctic ſnows, the tropic year.
So from the burning Line, by Monſoons driven,
Clouds ſail in ſquadrons o'er the darkened heaven;

eaſterly direction, by their coming to a part of the ſurface of the earth which moves faſter than the latitude they come from. Hence the increaſe of the ice in the polar regions, by increaſing the cold of our climate, adds, at the ſame time, to the bulk of the Glaciers of Italy and Switzerland.

If the nations who inhabit this hemiſphere of the globe, inſtead of deſtroying their ſeamen, and exhauſting their wealth in unneceſſary wars, could be induced to unite their labours to navigate theſe immenſe maſſes of ice into the more ſouthern oceans, two great advantages would reſult to mankind; the tropic countries would be much cooled by their ſolution, and our winters, in this latitude, would be rendered much milder, for perhaps a century or two, till the maſſes of ice become again enormous.

Mr. Bradley aſcribes the cold winds and wet weather which ſometimes happen in May and June, to the ſolution of ice-iſlands accidentally floating from the north. Treatiſe on Huſbandry and Gardening, vol. II. p. 437. And adds, that Mr. Barham, about the year 1718, in his voyage from Jamaica to England, in the beginning of June, met with ice-iſlands coming from the north, which were ſurrounded with ſo great a fog, that the ſhip was in danger of ſtriking upon them, and that one of them meaſured ſixty miles in length.

We have lately experienced an inſtance of ice-iſlands brought from the ſouthern polar regions, on which the Guardian ſtruck at the beginning of her paſſage from the Cape of Good-Hope towards Botany-Bay, on December 22, 1789. Theſe iſlands were involved in miſt, were about one hundred and fifty fathoms long, and about fifty fathoms above the ſurface of the water. A part from the top of one of them broke off, and fell into the ſea, cauſing an extraordinary commotion in the water, and a thick ſmoke all round it.

*Threefold train.* l. 539. The river Niger, after traverſing an immenſe tract of populous country, is ſuppoſed to divide itſelf into three other great rivers; the Rio Grande, the Gambia, and the Senegal. Gold-duſt is obtained from the ſands of theſe rivers.

Wide waſtes of ſand the gelid gales pervade,
And Ocean cools beneath the moving ſhade.

XII. Should SOLSTICE, ſtalking through the ſickening bowers,
Suck the warm dew-drops, lap the falling ſhowers; 550
Kneel, with parch'd lip, and bending from its brink,
From dripping palm the ſcanty river drink;
*Nymphs!* o'er the ſoil ten thouſand points erect,
And high in air the electric flame collect.
Soon ſhall dark miſts, with ſelf-attraction, ſhroud 555
The blazing day, and ſail in wilds of cloud;
Each ſilvery Flower the ſtreams aërial quaff,
Bow her ſweet head, and infant Harveſt laugh.

"Thus when ELIJA mark'd from Carmel's brow
In bright expanſe the briny flood below; 560
Roll'd his red eyes amid the ſcorching air,
Smote his firm breaſt, and breath'd his ardent prayer;

---

*Wide waſtes of ſand.* l. 547. When the ſun is in the ſouthern tropic, 36 deg. diſtant from the zenith, the thermometer is ſeldom lower than 72 deg. at Gondar, in Abyſſinia, but it falls to 60 or 53 deg. when the ſun is immediately vertical; ſo much does the approach of rain counteract the heat of the ſun. Bruce's Travels, vol. III. p. 670.

*Ten thouſand points erect.* l. 553. The ſolution of water in air, or in calorique, ſeems to acquire electric matter, at the ſame time, as appears from an experiment of Mr. Bennet. He put ſome live coals into an inſulated funnel of metal, and throwing on them a little water, obſerved, that the aſcending ſteam was electriſed plus, and the water which deſcended through the funnel was electriſed minus. Hence it appears, that though clouds, by their change of form, may ſometimes become electriſed minus, yet they have, in general, an accumulation of electricity. This accumulation of electric matter alſo evidently contributes to ſupport the atmoſpheric vapour when it is condenſed into the form of clouds, becauſe it is ſeen to deſcend rapidly after the flaſhes of lightning have diminiſhed its quantity; whence there is reaſon to conclude, that very numerous metallic rods, with fine points erected high in the air, might induce it, at any time, to part with ſome of its water.

If we may truſt the theory of Mr. Lavoiſier concerning the compoſition and decompoſition of water, there would ſeem another ſource of thunder-ſhowers; and that is, that the two gaſſes termed oxygene gas, or vital air, and hydrogene gas, or inflammable air, may exiſt in the ſummer atmoſphere in a ſtate of mixture, but not of combination, and that the electric ſpark, or flaſh of lightning, may combine them, and produce water inſtantaneouſly.

High in the midſt a maſſy altar ſtood,
And ſlaughter'd offerings preſs'd the piles of wood;
While Israel's chiefs the ſacred hill ſurround,
And famiſh'd armies croud the duſty ground;
While proud Idolatry was leagu'd with dearth,
And wither'd Famine ſwept the deſert earth.—
" *Oh, mighty* Lord ! thy woe-worn ſervant hear,
" Who calls thy name in agony of prayer;
" Thy fanes diſhonour'd, and thy prophets ſlain,
" Lo! I alone ſurvive of all thy train!—
" Oh, ſend from heaven thy ſacred fire—and pour
" O'er the parch'd land the ſalutary ſhower,—
" So ſhall thy Prieſt thy erring flock recal,—
" And ſpeak in thunder, *Thou art Lord of all.*"—
He cried, and kneeling on the mountain-ſands,
Stretch'd high in air his ſupplicating hands.
—Deſcending flames the duſky ſhrine illume;
Fire the wet wood, the ſacred bull conſume;
Wing'd from the ſea the gathering miſts ariſe,
And floating waters darken all the ſkies;
The King, with ſhifted reins, his chariot bends,
And wide o'er earth the airy flood deſcends;
With mingling cries diſperſing hoſts applaud,
And ſhouting nations own the living God."

The *Goddeſs* ceaſed—the exulting tribes obey,
Start from the ſoil, and win their airy way;
The vaulted ſkies, with ſtreams of tranſient rays,
Shine, as they paſs, and earth and ocean blaze.
So from fierce wars, when lawleſs Monarchs ceaſe,
Or Liberty returns with laurel'd Peace,
Bright fly the ſparks, the colour'd luſtres burn,
Flaſh follows flaſh, and flame-wing'd circles turn;
Blue ſerpents ſweep along the duſky air,
Imp'd by long trains of ſcintillating hair;
Red rockets riſe, loud cracks are heard on high,
And ſhowers of ſtars ruſh headlong from the ſky,
Burſt, as in ſilver lines they hiſs along,
And the quick flaſh unfolds the gazing throng.

# ARGUMENT

### OF THE

## *SECOND CANTO.*

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# THE
# BOTANIC GARDEN.

## ECONOMY OF VEGETATION.

### CANTO II.

AND *now the Goddeſs*, with attention ſweet,
Turns to the *Gnomes* that circle round her feet;
Orb within orb approach the marſhal'd trains,
And pigmy legions darken all the plains;
Thrice ſhout, with ſilver tones, the applauding bands,
Bow, ere She ſpeaks, and clap their fairy hands.
So the tall graſs, when noon-tide zephyr blows,
Bends its green blades in undulating rows;
Wide o'er the fields the billowy tumult ſpreads,
And ruſtling harveſts bow their golden heads.

I. " *Gnomes! your* bright forms, preſiding at her birth,
Clung in fond ſquadrons round the new-born *Earth*;
When high in ether, with exploſion dire,
From the deep craters of his realms of fire,
The whirling Sun this ponderous planet hurl'd,
And gave the aſtoniſh'd void another world.
When from its vaporous air, condenſed by cold,
Deſcending torrents into oceans roll'd;

*From the deep craters.* l. 14. The exiſtence of ſolar volcanos is countenanced by their analogy to terreſtrial and lunar volcanos, and by the ſpots on the ſun's diſk, which have been ſhewn by Dr. Wilſon to be excavations through its luminous ſurface, and may be ſuppoſed to be the cavities from whence the planets and comets were ejected by exploſions. See additional notes, No. XV. on ſolar volcanos.

*When from its vaporous air.* l. 17. If the nucleus of the earth was thrown out from the ſun by an exploſion, along with as large a quantity of ſurrounding hot vapour as its attraction would occaſion to accompany it, the ponderous ſemi-fluid nucleus, would take a ſpherical form, from the attrac-

And fierce attraction, with relentleſs force,
Bent the reluctant wanderer to its courſe.

"Where yet the Bull, with diamond-eye, adorns
The Spring's fair forehead, and with golden horns;
Where yet the Lion climbs the ethereal plain,
And ſhakes the Summer from his radiant mane;
Where Libra lifts her airy arm, and weighs,
Poiſed in her ſilver balance, nights and days;
With paler luſtres where Aquarius burns,
And ſhowers the ſtill ſnow from his hoary urns;
*Your* ardent troops purſued the flying ſphere,
Circling the ſtarry girdle of the year;
While ſweet viciſſitudes of day and clime
Mark'd the new annals of enaſcent Time.

II. "*You* trod, with printleſs ſtep, Earth's tender globe,
While Ocean wrap'd it in his azure robe;
Beneath his waves her hardening ſtrata ſpread,
Raiſed her *Primeval Iſlands* from his bed,

tion of its own parts, which would become an oblate ſpheroid from its diurnal revolution. As the vapour cooled the water would be precipitated, and an ocean would ſurround the ſpherical nucleus with a ſuper-incumbent atmoſphere. The nucleus of ſolar lava would likewiſe become harder as it became cooler. To underſtand how the ſtrata of the earth were afterwards formed from the ſediments of this circumfluent ocean, the reader is referred to an ingenious Treatiſe on the Theory of the Earth, by Mr. Whitehurſt, who was many years a watch-maker and engineer at Derby, but whoſe ingenuity, integrity, and humanity, were rarely equalled in any ſtation of life.

*While Ocean wrap'd.* l. 34. See additional notes, No. XVI. on the production of calcareous earth.

*Her hardening ſtrata ſpread.* l. 35. The granite, or moor-ſtone, or porphory, conſtitute the oldeſt part of the globe, ſince the lime-ſtone, ſhells, coralloids, and other ſea productions, reſt upon them; and upon theſe ſea productions are found clay, iron, coal, ſalt, and ſiliceous ſand, or grit-ſtone. Thus there ſeem to be three diviſions of the globe diſtinctly marked: the firſt I ſuppoſe to have been the original nucleus of the earth, or lava projected from the ſun; 2. over this lie the recrements of animal and vegetable matter produced in the ocean; and, 3. over theſe the recrements of animal and vegetable matter produced upon the land. Beſides theſe there are bodies which owe their origin to a combination of thoſe already mentioned, as ſiliceous ſand, fluor, alabaſter, which ſeem to have derived their acids orginally from the vegetable kingdom, and their earthy baſes from ſea productions. See additional notes, No. XVI. on calcareous earth.

*Raiſed her Primeval Iſlands.* l. 36. The nucleus of the earth, ſtill covered

Stretch'd her wide lawns, and ſunk her winding dells,
And deck'd her ſhores with corals, pearls, and ſhells.

"O'er thoſe bleſt iſles no ice-crown'd mountains tower'd,
No lightnings darted, and no tempeſts lower'd;
Soft fell the veſper-drops, condenſed below,
Or bent in air the rain-refracted bow;
Sweet breathed the zephyrs, juſt perceiv'd and loſt;
And brineleſs billows only kiſs'd the coaſt;
Round the bright zodiac danc'd the vernal hours,
And Peace, the Cherub, dwelt in mortal bowers!

"So young DIONE, nurſed beneath the waves,
And rock'd by Nereids in their coral caves,
Charm'd the blue ſiſterhood with playful wiles,
Liſp'd her ſweet tones, and tried her tender ſmiles.

with water, received perpetual increaſe by the immenſe quantities of ſhells and coralloids either annually produced and relinquiſhed, or left after the death of the animals. Theſe would gradually, by their different degrees of coheſion, be, ſome of them more and others leſs, removeable, by the influence of ſolar tides, and gentle tropical breezes, which then muſt have probably extended from one pole to the other; for it is ſuppoſed the moon was not yet produced, and that no ſtorms, or unequal winds, had yet exiſtence.

Hence, then, the primeval iſlands had their gradual origin, were raiſed but a few feet above the level of the ſea, and were not expoſed to the great or ſudden variations of heat and cold, as is ſo well explained in Mr. Whitehurſt's Theory of the Earth, chap. xvi. Whence the paradiſe of the ſacred writers, and the golden age of the profane ones, ſeems to have had a real exiſtence. As there can be no rainbow, when the heavens are covered with clouds, becauſe the ſun-beams are then precluded from falling upon the rain-drops oppoſite to the eye of the ſpectator, the rainbow is a mark of gentle or partial ſhowers. Mr. Whitehurſt has endeavoured to ſhow, that the primitive iſlands were only moiſtened by nocturnal dews, and not by ſhowers, as occurs at this day to the Delta of Egypt; and is thence of opinion, that the rainbow had no exiſtence till after the production of mountains and continents. As the ſalt of the ſea has been gradually accumulating, being waſhed down into it from the recrements of animal and vegetable bodies, the ſea muſt originally have been as freſh as river water; and as it is not yet ſaturated with ſalt, muſt become annually more ſaline. See note on l. 117 of this Canto.

*So young Dione.* l. 47. There is an ancient gem repreſenting Venus riſing out of the ocean, ſupported by two Tritons. From the formality of the deſign, it would appear to be of great antiquity, before the introduction of fine taſte into the world. It is probable, that this beautiful allegory was originally an hieroglyphic picture (before the invention of letters) deſcriptive of the formation of the earth from the ocean, which ſeems to have been an opinion of many of the moſt ancient philoſophers.

Then, on her beryl throne, by Tritons borne,
Bright roſe the Goddeſs like the Star of morn;
When with ſoft fires the milky dawn He leads,
And wakes to life and love the laughing meads;—
With roſy fingers, as uncurl'd they hung
Round her fair brow, her golden locks ſhe wrung;
O'er the ſmooth ſurge on ſilver ſandals ſtood,
And look'd enchantment on the dazzled flood.—
The bright drops rolling from her lifted arms,
In ſlow meanders wander o'er her charms,
Seek round her ſnowy neck their lucid track,
Pearl her white ſhoulders, gem her ivory back,
Round her fine waiſt and ſwelling boſom ſwim,
And ſtar with glittering brine each cryſtal limb.—
—The immortal form enamour'd Nature hail'd,
And Beauty blazed to heaven and earth, unveil'd.

III. "*You!* who then, kindling after many an age,
Saw, with new fires, the firſt volcano rage,

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*The firſt volcano.* l. 68. As the earth, before the exiſtence of earthquakes, was nearly level, and the greateſt part of it covered with ſea; when the firſt great fires began deep in the internal parts of it, thoſe parts would become much expanded; this expanſion would be gradually extended, as the heat increaſed, through the whole terraqueous globe of 7000 miles diameter; the cruſt would thence, in many places, open into fiſſures, which, by admitting the ſea to flow in upon the fire, would produce not only a quantity of ſteam beyond calculation, by its expanſion, but would alſo, by its decompoſition, produce inflammable air and vital air in quantities beyond conception, ſufficient to effect thoſe violent exploſions, the veſtiges of which, all over the world, excite our admiration and our ſtudy. The difficulty of underſtanding how ſubterraneous fires could exiſt without the preſence of air, has diſappeared ſince Dr. Prieſtley's diſcoveries of ſuch great quantities of pure air, which conſtitute all the acids, and, conſequently, exiſt in all ſaline bodies, as ſea-ſalt, nitre, lime-ſtone, and in all calciform ores, as manganeſe, calamy, ochre, and other mineral ſubſtances. See an ingenious treatiſe, by Mr. Michel, on earthquakes, in the Philoſ. Tranſ.

In theſe firſt tremendous ignitions of the globe, as the continents were heaved up, the vallies, which now hold the ſea, were formed by the earth, ſubſiding into the cavities made by the riſing mountains, as the ſteam which raiſed them condenſed; which would thence not have any caverns of great extent remain beneath them, as ſome philoſophers have imagined. The earthquakes of modern days are of very ſmall extent indeed, compared to thoſe of ancient times, and are ingeniouſly compared, by M. De Luc, to the operations of a mole-hill, where, from a ſmall cavity, are raiſed, from time to time, ſmall quantities of lava, or pumice-ſtone. Monthly Review, June, 1790.

O'er ſmouldering heaps of livid ſulphur ſwell
At Earth's firm centre, and diſtend her ſhell,
Saw, at each opening cleft, the furnace glow,
And ſeas ruſh headlong on the gulphs below.
*Gnomes!* how you ſhriek'd, when through the troubled air
Roar'd the fierce din of elemental war;
When roſe the continents, and ſunk the main,
And Earth's huge ſphere, exploding, burſt in twain.
*Gnomes!* how you gazed, when from her wounded ſide,
Where now the South-Sea heaves its waſte of tide,
Roſe on ſwift wheels the MOON's refulgent car,
Circling the ſolar orb, a ſiſter ſtar,
Dimpled with vales, with ſhining hills emboſs'd,
And roll'd round earth her airleſs realms of froſt.

"*Gnomes* [illegible] how you trembled, with the dreadful force,
When Earth, recoiling, ſtagger'd from her courſe;

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*The Moon's refulgent car.* l. 79. See additional notes, No. XV. on ſolar volcanos.

*Her airleſs realms of froſt.* l. 82. If the moon had no atmoſphere at the time of its elevation from the earth, or if its atmoſphere was afterwards ſtolen from it by the earth's attraction, the water on the moon would riſe quickly into vapour, and the cold produced by a certain quantity of this evaporation, would congeal the remainder of it. Hence it is not probable that the moon is at preſent inhabited, but, as it ſeems to have ſuffered, and to continue to ſuffer much by volcanos, a ſufficient quantity of air may, in proceſs of time, be generated to produce an atmoſphere, which may prevent its heat from ſo eaſily eſcaping, and its water from ſo eaſily evaporating, and thence become fit for the production of vegetables and animals.

That the moon poſſeſſes little or no atmoſphere, is deduced from the undiminiſhed luſtre of the ſtars, at the inſtant when they emerge from behind her diſk. That the ocean of the moon is frozen, is confirmed from there being no appearance of lunar tides, which, if they exiſted, would cover the part of her diſk neareſt the earth. See note on Canto III. l. 61.

*When Earth, recoiling.* l. 84. On ſuppoſition that the moon was thrown from the earth by the exploſion of water, or the generation of other vapours of greater power, the remaining part of the globe would recede from its orbit in one direction as the moon receded in another, and that in proportion to the reſpective momentum of each, and would afterwards revolve round their common centre of gravity.

If the moon roſe from any part of the earth except exactly at the line or poles, the ſhock would tend to turn the axis of the earth out of its previous direction. And as a maſs of matter riſing from deep parts of the globe would have previouſly acquired leſs diurnal velocity than the earth's ſurface, from whence it roſe, it would receive, during the time of its riſing, addi-

When, as her Line in ſlower circles ſpun,
And her ſhock'd axis nodded from the ſun,
With dreadful march the accumulated main
Swept her vaſt wrecks of mountain, vale, and plain;
And, while new tides their ſhouting floods unite,
And hail their Queen, fair Regent of the night,
Chain'd to one centre, whirl'd the kindred ſpheres,
And mark'd with lunar cycles ſolar years.

IV. "*Gnomes! you* then bade diſſolving *Shells* diſtil
From the looſe ſummits of each ſhatter'd hill,
To each fine pore and dark interſtice flow,
And fill with liquid chalk the maſs below.
Whence ſparry forms in duſky caverns gleam
With borrow'd light, and twice refract the beam;
While in white beds congealing rocks beneath
Court the nice chiſſel, and deſire to breathe.—

tional velocity from the earth's ſurface, and would, conſequently, ſo much retard the motion of the earth round its axis.

When the earth thus receded, the ſhock would overturn all its buildings and foreſts, and the water would ruſh, with inconceivable violence, over its ſurface, towards the new ſatellite, from two cauſes, both by its not at firſt acquiring the velocity with which the earth receded, and by the attraction of the new moon, as it leaves the earth: on theſe accounts, at firſt, there would be but one tide till the moon receded to a greater diſtance, and the earth, moving round a common centre of gravity between them, the water on the ſide fartheſt from the moon would acquire a centrifugal force, in reſpect to this common centre, between itſelf and the moon.

*Diſſolving ſhells diſtil.* l. 93. The lime-ſtone rocks have had their origin from ſhells formed beneath the ſea, the ſofter ſtrata gradually diſſolving, and filling up the interſtices of the harder ones; afterwards, when theſe accumulations of ſhells were elevated above the waters, the upper ſtrata became diſſolved by the actions of the air and dews, and filled up the interſtices beneath, producing ſolid rocks of different kinds, from the coarſe lime-ſtones to the fineſt marbles. When thoſe lime-ſtones have been in ſuch a ſituation that they could form perfect cryſtals, they are called ſpars, ſome of which poſſeſs a double refraction, as obſerved by Sir Iſaac Newton. When theſe cryſtals are jumbled together, or mixed with ſome colouring impurities, it is termed marble, if its texture be equable and firm; if its texture be coarſe and porous, yet hard, it is called lime-ſtone; if its texture be very looſe and porous, it is termed chalk. In ſome rocks the ſhells remain almoſt unchanged, and only covered, or bedded, with lime-ſtone, which ſeems to have been diſſolved, and ſunk down amongſt them. In others the ſofter ſhells and bones are diſſolved, and only ſhark's teeth, or harder echini, have preſerved their form, inveloped in the chalk or lime-ſtone. In ſome marbles the ſolution has been complete, and no veſtiges of ſhell appear, as in the white kind, called ſtatuary by the workmen. See additional notes, No. XVI.

" Hence wearied HERCULES in marble rears
His languid limbs, and reſts a thouſand years;
Still, as he leans ſhall young ANTINOUS pleaſe
With careleſs grace, and unaffected eaſe;
Onward, with loftier ſtep, APOLLO ſpring,
And launch the unerring arrow from the ſtring;
In Beauty's baſhful form, the veil unfurl'd,
Ideal VENUS win the gazing world.
Hence, on ROUBILIAC's tomb ſhall Fame ſublime
Wave her triumphant wings, and conquer Time;
Long with ſoft touch ſhall DAMER's chiſſel charm,
With grace delight us, and with beauty warm;
FOSTER's fine form ſhall hearts unborn engage,
And MELBOURN's ſmile enchant another age.

V. " *Gnomes! you* then taught tranſuding dews to paſs
Through time-fall'n woods, and root-inwove moraſs
Age after age; and with filtration fine
Diſpart, from earths and ſulphurs, the ſaline.

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*Hence wearied Hercules.* l. 101. Alluding to the celebrated Hercules of Glyco reſting after his labours; and to the eaſy attitude of Antinous; the lofty ſtep of the Apollo of Belvidere; and the retreating modeſty of the Venus de Medici. Many of the deſigns of Roubiliac, in Weſtminſter Abbey, are uncommonly poetical; the allegory of Time and Fame contending for the trophy of General Wade, which is here alluded to, is beautifully told; the wings of Fame are ſtill expanded, and her hair ſtill floating in the air; which not only ſhews that ſhe has that moment arrived, but alſo that her force is not yet expended; at the ſame time that the old figure of Time, with his diſordered wings, is rather leaning backwards, and yielding to her impulſe, and muſt apparently, in another inſtant, be driven from his attack upon the trophy.

*Foſter's fine form.* l. 113. Alluding to the beautiful ſtatues of Lady Elizabeth Foſter, and of Lady Melbourn, executed by the honourable Mrs. Damer.

*Root-inwove moraſs.* l. 116. The great maſs of matter which reſts upon the lime-ſtone ſtrata of the earth, or upon the granite, where the lime-ſtone ſtratum has been removed by earthquakes, or covered by lava, has had its origin from the recrements of vegetables and of air-breathing animals, as the lime-ſtone had its origin from ſea animals. The whole habitable world was originally covered with woods, till mankind formed themſelves into ſocieties, and ſubdued them by fire and by ſteel. Hence woods, in uncultivated countries, have grown and fallen through many ages, whence moraſſes of immenſe extent; and from theſe, as the more ſoluble parts were waſhed away firſt, were produced ſea-ſalt, nitre, iron, and variety of acids, which, combining with calcareous matter, were productive of many foſſil bodies, as flint, ſea-ſand, ſelenite, with the precious ſtones, and perhaps the diamond. See additional notes, No. XVII.

I. "*Hence*, with diffuſive *Salt* old Ocean ſteeps
His emerald ſhallows, and his ſapphire deeps.
Oft in wide lakes, around their warmer brim,
In hollow pyramids the cryſtals ſwim;
Or, fuſed by earth-born fires, in cubic blocks
Shoot their white forms, and harden into rocks.

"Thus, cavern'd round in CRACOW's mighty mines,
With cryſtal walls a gorgeous city ſhines;
Scoop'd in the briny rock long ſtreets extend
Their hoary courſe, and glittering domes aſcend;

*Hence, with diffuſive Salt.* l. 119. Salts of various kinds are produced from the recrements of animal and vegetable bodies, ſuch as phoſphoric, ammoniacal, marine ſalt, and others; theſe are waſhed from the earth by rains, and carried down our rivers into the ſea; they ſeem all here to decompoſe each other, except the marine ſalt, which has, therefore, from the beginning of the habitable world, been perpetually accumulating.

There is a town in the immenſe ſalt-mines of Cracow, in Poland, with a market-place, a river, a church, and a famous ſtatue, (here ſuppoſed to be of Lot's wife) by the moiſt or dry appearance of which the ſubterranean inhabitants are ſaid to know when the weather is fair above ground. The galleries in theſe mines are ſo numerous and ſo intricate, that workmen have frequently loſt their way, their lights having been burnt out, and have periſhed before they could be found. Eſſais, &c. par M. Macquart. And though the arches of theſe different ſtories of galleries are boldly executed, yet they are not dangerous, as they are held together, or ſupported, by large maſſes of timber of a foot ſquare; and theſe vaſt timbers remain perfectly ſound for many centuries, while all other pillars, whether of brick, cement, or ſalt, ſoon diſſolve, or moulder away. Ibid. Could the timbers over water-mill wheels or cellars, be thus preſerved by occaſionally ſoaking them with brine? Theſe immenſe maſſes of rock-ſalt ſeem to have been produced by the evaporation of ſea-water, in the early periods of the world, by ſubterranean fires. Dr. Hutton's Theory of the Earth. See alſo Theorie des Sources Salees, par M. Struve. Hiſtoire de Sciences de Lauſanne, Tom. II. This idea of Dr. Hutton's is confirmed by a fact mentioned in M. Macquart's Eſſais ſur Mineralogie, who found a great quantity of foſſil ſhells, principally bi-valves and madre-pores, in the ſalt-mines of Wialiczka, near Cracow. During the evaporation of the lakes of ſalt-water, as in artificial ſalt-works, the ſalt begins to cryſtallize near the edge, where the water is ſhalloweſt, forming hollow inverted pyramids, which, when they become of a certain ſize, ſubſide by their gravity; if urged by a ſtronger fire, the ſalt fuſes, or forms large cubes; whence the ſalt ſhaped in hollow pyramids, called flake-ſalt, is better taſted, and preſerves fleſh better, than the baſket or powder ſalt; becauſe it is made by leſs heat, and thence contains more of the marine acid. The ſea-water about our iſland contains from about one twenty-eighth to one thirtieth part of ſea-ſalt, and about one eightieth of magneſian ſalt. See Brownrigg on Salt. See note on Ocymum, vol. II. of this work.

Down the bright ſteeps, emerging into day,
Impetuous fountains burſt their headlong way,
O'er milk-white vales in ivory channels ſpread,
And wandering, ſeek their ſubterraneous bed.
Form'd in pellucid ſalt, with chiſſel nice,
The pale lamp glimmering through the ſculptured ice,
With wild reverted eyes fair LOTTA ſtands,
And ſpreads to Heaven, in vain, her glaſſy hands;
Cold dews condenſe upon her pearly breaſt,
And the big tear rolls lucid down her veſt.
Far gleaming o'er the town tranſparent fanes
Rear their white towers, and wave their golden vanes;
Long lines of luſtres pour their trembling rays,
And the bright vault returns the mingled blaze.

2. " *Hence* orient *Nitre* owes its ſparkling birth,
And with priſmatic cryſtals gems the earth,

*Hence orient Nitre.* l. 143. Nitre is found in Bengal naturally cryſtallized, and is ſwept by brooms from earths and ſtones, and thence called ſweepings of nitre. It has lately been found, in large quantities, in a natural baſon of calcareous earth at Molfetta, in Italy, both in thin ſtrata between the calcareous beds, and in efflorefcences of various beautiful leafy and hairy forms. An account of this nitre-bed is given by Mr. Zimmerman, and abridged in Rozier's Journal de Phyſique, Fevrier, 1790. This acid appears to be produced in all ſituations where animal and vegetable matters are completely decompoſed, and which are expoſed to the action of the air, as on the walls of ſtables and ſlaughter-houſes; the cryſtals are priſms furrowed by longitudinal grooves.

Dr. Prieſtley diſcovered, that nitrous air or gas, which he obtained by diſſolving metals in nitrous acid, would combine rapidly with vital air, and produce with it a true nitrous acid, forming red clouds during the combination; the two airs occupy only the ſpace before occupied by one of them, and, at the ſame time, heat is given out from the new combination. This diminution of the bulk of a mixture of nitrous gas and vital air, Dr. Prieſtley ingeniouſly uſed as a teſt of the purity of the latter; a diſcovery of the greateſt importance in the analyſis of airs.

Mr. Cavendiſh has ſince demonſtrated, that two parts of vital air, or oxygene, and one part of phlogiſtic air, or azote, being long expoſed to electric ſhocks, unite, and produce nitrous acid. Philoſ. Tranſ. vols. LXXV. and LXXVIII.

Azote is one of the moſt abundant elements in nature, and, combined with calorique, or heat, it forms azotic gas, or phlogiſtic air, and compoſes two thirds of the atmoſphere, and is one of the principal component parts of animal bodies, and, when united to vital air, or oxygene, produces the nitrous acid. Mr. Lavoiſier found that $21\frac{1}{2}$ parts, by weight, of azote, and $43\frac{1}{2}$ parts of oxygene, produced 64 parts of nitrous gas; and, by the further

O'er tottering domes in filmy foliage crawls,
Or froſts with branching plumes the mouldering walls.
As woos Azotic Gas the virgin Air,
And veils in crimſon clouds the yielding Fair;
Indignant Fire the treacherous courtſhip flies,
Waves his light wing, and mingles with the ſkies.

"So Beauty's *Goddeſs*, warm with new deſire,
Left, on her ſilver wheels, the GOD of Fire;
Her faithleſs charms to fiercer MARS reſign'd,
Met with fond lips, with wanton arms intwin'd.
—Indignant VULCAN eyed the parting Fair,
And watch'd, with jealous ſtep, the guilty pair;
O'er his broad neck a wiry net he flung,
Quick as he ſtrode, the tinkling meſhes rung;
Fine as the ſpider's flimſy thread He wove
The immortal toil to lime illicit love;
Steel were the knots, and ſteel the twiſted thong,
Ring link'd in ring, indiſſolubly ſtrong;
On viewleſs hooks, along the fretted roof,
He hung, unſeen, the inextricable woof.—
—Quick ſtart the ſprings, the webs pellucid ſpread,
And lock the embracing Lovers on their bed;
Fierce with loud taunts vindictive VULCAN ſprings,
Tries all the bolts, and tightens all the ſtrings,
Shakes, with inceſſant ſhouts, the bright abodes,
Claps his rude hands, and calls the feſtive Gods.—
—With ſpreading palms the alarmed Goddeſs tries
To veil her beauties from celeſtial eyes,
Writhes her fair limbs, the ſlender ringlets ſtrains,
And bids her Loves untie the obdurate chains;
Soft ſwells her panting boſom, as ſhe turns,
And her fluſh'd cheek with brighter bluſhes burns.
Majeſtic grief the Queen of Heaven avows,
And chaſte Minerva hides her helmed brows;

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addition of 36 parts of oxygene, nitrous acid was produced. Traité de Chimie. When two airs become united ſo as to produce an unelaſtic liquid, much calorique, or heat, is, of neceſſity, expelled from the new combination, though, perhaps, nitrous acid, and oxygenated marine acid, admit more heat into their combinations than other acids.

Attendant Nymphs, with baſhful eyes aſkance,
Steal of intangled MARS a tranſient glance;
Surrounding Gods the circling nectar quaff,
Gaze on the Fair, and envy as they laugh.

3. " *Hence* duſky *Iron* ſleeps in dark abodes,
And ferny foliage neſtles in the nodes;
'Till with wide lungs the panting bellows blow,
And waked by fire the glittering torrents flow;
—Quick whirls the wheel, the ponderous hammer falls,
Loud anvils ring amid the trembling walls,
Strokes follow ſtrokes, the ſparkling ingot ſhines,
Flows the red ſlag, the lengthening bar refines;
Cold waves, immerſed, the glowing maſs congeal,
And turn to adamant the hiſſing Steel.

*Hence duſky Iron*. l. 183. The production of iron from the decompoſition of vegetable bodies, is perpetually preſented to our view; the waters oozing from all moraſſes are chalybeate, and depoſit their ochre on being expoſed to the air, the iron acquiring a calciform ſtate from its union with oxygene, or vital air. When thin moraſſes lie on beds of gravel, the latter are generally ſtained by the filtration of ſome of the chalybeate water through them. This formation of iron from vegetable recrements, is further evinced by the fern leaves, and other parts of vegetables, ſo frequently found in the centre of the knobs or nodules of ſome iron ores.

In ſome of theſe nodules there is a nucleus of whiter iron earth, ſurrounded by many concentric ſtrata of darker and lighter iron earth alternately. In one, which now lies before me, the nucleus is a priſm of a triangular form, with blunted angles, and about half an inch high, and an inch and half broad; on every ſide of this are concentric ſtrata of ſimilar iron earth, alternately browner and leſs brown; each ſtratum is about a tenth of an inch in thickneſs, and there are ten of them in number. To what known cauſe can this exactly regular diſtribution of ſo many earthy ſtrata of different colours, ſurrounding the nucleus, be aſcribed? I don't know that any mineralogiſts have attempted an explanation of this wonderful phenomenon. I ſuſpect it is owing to the polarity of the central nucleus. If iron-filings be regularly laid on paper, by means of a ſmall ſieve, and a magnet be placed underneath, the filings will diſpoſe themſelves in concentric curves, with vacant intervals between them. Now, if theſe iron-filings are conceived to be ſuſpended in a fluid, whoſe ſpecific gravity is ſimilar to their own, and a magnetic bar was introduced as an axis into this fluid, it is eaſy to foreſee that the iron-filings would diſpoſe themſelves into concentric ſpheres, with intervals of the circumnatant fluid between them, exactly as is ſeen in theſe nodules of iron earth. As all the lavas conſiſt of one fourth of iron, (Kirwan's Mineral.) and almoſt all other known bodies, whether of animal or vegetable origin, poſſeſs more or leſs of this property, may not a diſtribution of a great portion of the globe of the earth, into ſtrata of greater or leſs regularity, be owing to the polarity of the whole?

*And turn to adamant*. l. 192. The circumſtances which render iron more

"Laſt Michel's hands, with touch of potent charm,
The poliſh'd rods with powers magnetic arm;
With points directed to the polar ſtars, 195
In one long line extend the temper'd bars;

valuable to mankind than any other metal, are, 1. Its property of being rendered hard to ſo great a degree, and thus conſtituting ſuch excellent tools It was the diſcovery of this property of iron, Mr. Locke thinks, that gave ſuch pre-eminence to the European world over the American one. 2. Its power of being welded; that is, when two pieces are made very hot, and applied together by hammering, they unite completely, unleſs any ſcale of iron intervenes; and to prevent this it is uſual for ſmiths to dip the very hot bar in ſand, a little of which fuſes into fluid glaſs with the ſcale, and is ſqueezed out from between the uniting parts by the force of hammering. 3. Its power of acquiring magnetiſm.

It is, however, to be wiſhed, that gold or ſilver were diſcovered in as great quantity as iron, ſince theſe metals, being indeſtructible by expoſure to air, water, fire, or any common acids, would ſupply wholeſome veſſels for cookery, ſo much to be deſired, and ſo difficult to obtain, and would form the moſt light and durable coverings for houſes, as well as indeſtructible fire-grates, ovens, and boiling veſſels. See additional notes, No. XVIII. on Steel.

*Laſt Michel's hands.* l. 193. The diſcovery of the magnet ſeems to have been in very early times; it is mentioned by Plato, Lucretius, Pliny, and Galen, and is ſaid to have taken its name of magnes, from Magneſia, a ſea-port of ancient Lybia.

As every piece of iron which was made magnetical by the touch of a magnet, became itſelf a magnet, many attempts were made to improve theſe artificial magnets, but without much ſucceſs, till Servingdon Savery, Eſq. made them of *hardened* ſteel bars, which were ſo powerful, that one of them, weighing three pounds averdupois, would lift another of the ſame weight. Philoſ. Tranſ.

After this Dr. Knight made very ſucceſsful experiments on this ſubject, which, though he kept his method ſecret, ſeems to have excited others to turn their attention to magnetiſm. At this time the Rev. Mr. Michel invented an equally efficacious and more expeditious way of making ſtrong artificial magnets, which he publiſhed in the end of the year 1750, in which he explained his method of what he called "the double touch," and which, ſince Dr. Knight's method has been known, appears to be ſomewhat different from it.

This method of rendering bars of hardened ſteel magnetical, conſiſts in holding vertically two or more magnetic bars nearly parallel to each other, with their oppoſite poles very near each other, (but neverthe leſs ſeparated to a ſmall diſtance,) theſe are to be ſlided over a line of bars, laid horizontally, a few times backward and forward. See Michel on Magnetiſm, alſo a detailed account in Chambers' Dictionary.

What Mr. Michel propoſed by this method was, to include a very ſmall portion of the horizontal bars intended to be made magnetical, between the joint forces of two or more bars already magnetical, and, by ſliding them from end to end, every part of the line of bars became ſucceſſively included, and thus bars, poſſeſſed of a very ſmall degree of magnetiſm to begin with, would, in a few times ſliding backwards and forwards, make the other ones much more magnetical than themſelves, which are then to be taken up

Then thrice and thrice with ſteady eye he guides,
And o'er the adheſive train the magnet ſlides;
The obedient Steel with living inſtinct moves,
And veers for ever to the pole it loves.

"Hail, adamantine *Steel!* magnetic Lord!
King of the prow, the plowſhare, and the ſword!
True to the pole, by thee the pilot guides
His ſteady helm amid the ſtruggling tides,
Braves with broad ſail the immeaſurable ſea,
Cleaves the dark air, and aſks no ſtar but Thee.—
By thee the plowſhare rends the matted plain,
Inhumes in level rows the living grain;
Intruſive foreſts quit the cultured ground,
And Ceres laughs with golden fillets crown'd.—
O'er reſtleſs realms when ſcowling Diſcord flings
Her ſnakes, and loud the din of battle rings;
Expiring Strength, and vanquiſh'd Courage feel
Thy arm reſiſtleſs, adamantine *Steel!*

4. "*Hence* in fine ſtreams diffuſive *Acids* flow,
Or wing'd with fire o'er Earth's fair boſom blow;

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and uſed to touch the former, which are in ſucceſſion to be laid down horizontally in a line.

There is ſtill a great field remains for future diſcoveries in magnetiſm, both in reſpect to experiment and theory; the latter conſiſts of vague conjectures, the more probable of which are, perhaps, thoſe of Epinus, as they aſſimilate it to electricity.

One conjecture I ſhall add, viz. that the polarity of magnetiſm may be owing to the earth's rotatory motion. If heat, electricity, and magnetiſm, are ſuppoſed to be fluids of different gravities, heat being the heavieſt of them, electricity the next heavy, and magnetiſm the lighteſt, it is evident, that by the quick revolution of the earth, the heat will be accumulated moſt over the line, electricity next beneath this, and that the magnetiſm will be detruded to the poles and axis of the earth, like the atmoſpheres of common air and inflammable gas, as explained in the note on Canto I. l. 123.

Electricity and heat will both of them diſplace magnetiſm, and this ſhews that they may gravitate on each other; and hence, when too great a quantity of the electric fluid becomes accumulated at the poles by deſcending ſnows, or other unknown cauſes, it may have a tendency to riſe towards the tropics by its centrifugal force, and produce the northern lights. See additional notes, No. I.

*Diffuſive Acids flow.* l. 215. The production of marine acid from decompoſing vegetable and animal matters, with vital air, and of nitrous acid

Tranſmute to glittering Flints her chalky lands,
Or ſink on Ocean's bed in countleſs Sands.
Hence ſilvery Selenite her cryſtal moulds,
And ſoft Aſbeſtus ſmooths his ſilky folds; 220
His cubic forms phoſphoric Fluor prints,
Or rays in ſpheres his amethyſtine tints.
Soft cobweb clouds tranſparent Onyx ſpreads,
And playful Agates weave their colour'd threads;
Gay pictured Mochoes glow with landſcape-dyes, 225
And changeful Opals roll their lucid eyes;
Blue lambent light around the Sapphire plays,
Bright Rubies bluſh, and living Diamonds blaze.

from azote and vital air, the former of which is united to its baſis by means of the exhalations from vegetable and animal matters, conſtitute an analogy which induces us to believe, that many other acids have either their baſes, or are united to vital air by means of ſome part of decompoſing vegetable and animal matters.

The great quantities of flint-ſand, whether formed in mountains or in the ſea, would appear to derive its acid from the new world, as it is found above the ſtrata of lime-ſtone and granite which conſtitute the old world, and, as the earthy baſis of flint is probably calcareous, a great part of it ſeems to be produced by a conjunction of the new and old world. The recrements of air-breathing animals and vegetables probably afford the acid, and the ſhells of marine animals the earthy baſis, while another part may have derived its calcareous part alſo from the decompoſition of vegetable and animal bodies.

The ſame mode of reaſoning ſeems applicable to the ſiliceous ſtones under various names, as amethyſt, onyx, agate, mocho, opal, &c. which do not ſeem to have undergone any proceſs from volcanic fires, and as theſe ſtones only differ from flint by a greater or leſs admixture of argillaceous and calcareous earths. The different proportions of which, in each kind of ſtone, may be ſeen in Mr. Kirwan's valuable Elements of Mineralogy. See additional notes, No. XIX.

*Living diamonds blaze.* l. 228. Sir Iſaac Newton having obſerved the great power of refracting light, which the diamond poſſeſſes above all other cryſtallized or vitreous matter, conjectured that it was an inflammable body in ſome manner congealed. Inſomuch that all the light is reflected which falls on any of its interior ſurfaces at a greater angle of incidence than 24½ degrees; whereas an artificial gem of glaſs does not reflect any light from its hinder ſurface, unleſs that ſurface is inclined in an angle of 41 degrees. Hence, the diamond reflects half as much more light as a factitious gem in ſimilar circumſtances; to which muſt be added its great tranſparency, and the excellent poliſh it is capable of. The diamond had nevertheleſs been placed at the head of cryſtals or precious ſtones by the mineralogiſts, till Bergman ranged it of late in the combuſtible claſs of bodies, becauſe, by the focus of Villette's burning mirror, it was evaporated by a heat not much greater than will melt ſilver, and gave out light. Mr. Hoepfner, however, thinks the diſperſion of the diamond by this great heat, ſhould be called a phoſphoreſcent evaporation of it, rather than a combuſtion; and from its

“ Thus, for attractive earth, inconſtant Jove,
Maſk'd in new ſhapes, forſook his realms above.—
Firſt her ſweet eyes his Eagle-form beguiles,
And Hebe feeds him with ambroſial ſmiles;
Next the chang'd God a Cygnet's down aſſumes,
And playful Leda ſmooths his gloſſy plumes;
Then glides a ſilver ſerpent, treacherous gueſt!
And fair Olympia folds him in her breaſt;
Now lows a milk-white Bull on Afric's ſtrand,
And crops with dancing head the daiſy'd land.—
With roſy wreathes Europa's hand adorns
His fringed forehead, and his pearly horns;.
Light on his back the ſportive Damſel bounds,
And pleaſed he moves along the flowery grounds;
Bears with ſlow ſtep his beauteous prize aloof,
Dips in the lucid flood his ivory hoof;
Then wets his velvet knees, and wading laves
His ſilky ſides amid the dimpling waves.
While her fond train with beckoning hands deplore,
Strain their blue eyes, and ſhriek along the ſhore;
Beneath her robe ſhe draws her ſnowy feet,
And, half-reclining on her ermine ſeat,
Round his raiſed neck her radiant arms ſhe throws,
And reſts her fair cheek on his curled brows;
Her yellow treſſes wave on wanton gales,
And bent in air her azure mantle ſails.

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other analogies of cryſtallization, hardneſs, tranſparency, and place of its nativity, wiſhes again to replace it amongſt the precious ſtones. Obſerv. ſur. la Phyſique, par Rozier, Tom. XXXV. p. 448. See new edition of the tranſlation of Cronſtedt, by De Coſta.

*Inconſtant Jove.* l. 229. The purer air, or ether, in the ancient mythology, was repreſented by Jupiter, and the inferior air by Juno; and the conjunction of theſe deities was ſaid to produce the vernal ſhowers, and procreate all things, as is further ſpoken of in Canto III. l. 204. It is now diſcovered, that pure air, or oxygene, uniting with variety of baſes, forms the various kinds of acids; as the vitriolic acid from pure air and ſulphur; the nitrous acid from pure air and phlogiſtic air, or azote; and carbonic acid, (or fixed air,) from pure air and charcoal. Some of theſe affinities were, perhaps, pourtrayed by the Magi of Egypt, who were probably learned in chemiſtry, in their hieroglyphic pictures before the invention of letters, by the loves of Jupiter with terreſtrial ladies. And thus phyſically as well as metaphyſically might be ſaid, “ Jovis omnia plena.”

—Onward He moves, applauding Cupids guide,
And ſkim on ſhooting wing the ſhining tide;
Emerging Tritons leave their coral caves,
Sound their loud conchs, and ſmooth the circling waves,
Surround the timorous Beauty, as ſhe ſwims,
And gaze enamour'd on her ſilver limbs.
Now Europe's ſhadowy ſhores, with loud acclaim,
Hail the fair fugitive, and ſhout her name;
Soft echoes warble, whiſpering foreſts nod,
And conſcious Nature owns the preſent God.
Changed from the Bull, the rapturous God aſſumes
Immortal youth, with glow celeſtial blooms,
With lenient words her virgin fears diſarms,
And claſps the yielding Beauty in his arms;
Whence Kings and Heroes own illuſtrious birth,
Guards of mankind, and demigods on earth.

VI. "*Gnomes!* as you paſs'd beneath the labouring ſoil,
The guards and guides of Nature's chemic toil,
*You* ſaw, deep-ſepulchred in duſky realms,
Which Earth's rock-ribbed ponderous vault o'erwhelms,
With ſelf-born fires the maſs fermenting glow,
And flame-wing'd ſulphurs quit the earths below.

1. "*Hence* ductile *Clays* in wide expanſion ſpread,
Soft as the Cygnet's down, their ſnow-white bed;
With yielding flakes ſucceſſive forms reveal,
And change obedient to the whirling wheel.
Firſt CHINA's ſons, with early art elate,
Form'd the gay tea-pot, and the pictured plate;

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*With ſelf-born fires.* l. 275. After the accumulation of plains and mountains on the calcareous rocks, or granite, which had been previouſly raiſed by volcanic fires, a ſecond ſet of volcanic fires were produced by the fermentation of this new maſs, which, after the ſalts, or acids, and iron, had been waſhed away in part by elutriation, diſſipated the ſulphurous parts, which were inſoluble in water; whence argillaceous and ſiliceous earths were left in ſome places; in others, bitumen became ſublimed to the upper part of the ſtratum, producing coals of various degrees of purity.

*Hence ductile clays.* l. 277. See additional notes, No. XX.

Saw with illumin'd brow and dazzled eyes
In the red ſtove vitreſcent colours riſe;
Speck'd her tall beakers with enamel'd ſtars, 285
Her monſter-joſſes, and gigantic jars;
Smear'd her huge dragons with metallic hues,
With golden purples, and cobaltic blues;
Bade on wide hills her porcelain caſtles glare,
And glazed Pagodas tremble in the air. 290

" ETRURIA! next beneath thy magic hands
Glides the quick wheel, the plaſtic clay expands,
Nerved with fine touch, thy fingers (as it turns)
Mark the nice bounds of vaſes, ewers, and urns;
Round each fair form in lines immortal trace 295
Uncopied Beauty, and ideal Grace.

" *Gnomes!* as you now diſſect with hammers fine
The granite-rock, the nodul'd flint calcine;
Grind with ſtrong arm, the circling chertz betwixt,
Your pure Ka-o-lins and Pe-tun-tſes mixt; 300

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*Saw with illumin'd brow.* l. 283. No colour is diſtinguiſhable in the red-hot kiln but the red itſelf, till the workman introduces a ſmall piece of dry wood, which, by producing a white flame, renders all the other colours viſible in a moment.

*With golden purples.* l. 288. See additional notes, No. XXI.

*Etruria! next.* l. 291. Etruria may, perhaps, vie with China itſelf in the antiquity of its arts. The times of its greateſt ſplendour were prior to the foundations of Rome, and the reign of one of its beſt princes, Janus, was the oldeſt epoch the Romans knew. The earlieſt hiſtorians ſpeak of the Etruſcans as being then of high antiquity, moſt probably a colony from Phœnicia, to which a Pelaſgian colony acceded, and was united ſoon after Deucalion's flood. The peculiar character of their earthen vaſes conſiſts in the admirable beauty, ſimplicity, and diverſity of forms, which continue the beſt models of taſte to the artiſts of the preſent times; and in a ſpecies of non-vitreous encauſtic painting, which was reckoned, even in the time of Pliny, among the loſt arts of antiquity, but which has lately been recovered by the ingenuity and induſtry of Mr. Wedgwood. It is ſuppoſed that the principal manufactories were about Nola, at the foot of Veſuvius, for it is in that neighbourhood that the greateſt quantities of antique vaſes have been found; and it is ſaid that the general taſte of the inhabitants is apparently influenced by them, inſomuch that ſtrangers, coming to Naples, are commonly ſtruck with the diverſity and elegance, even of the moſt ordinary vaſes, for cammon uſes. See D'Hancarville's preliminary diſcourſes to the magnificent collection of Etruſcan vaſes, publiſhed by Sir William Hamilton.

O'er each red ſaggar's burning cave preſide,
The keen-eyed Fire-Nymphs blazing by your ſide;
And pleaſed on WEDGWOOD ray your partial ſmile,
A new Etruria decks Britannia's iſle.—
Charm'd by your touch, the flint liqueſcent pours
Through finer ſieves, and falls in whiter ſhowers;
Charm'd by your touch, the kneaded clay refines,
The biſcuit hardens, the enamel ſhines;
Each nicer mould a ſofter feature drinks,
The bold Cameo ſpeaks, the ſoft Intaglio thinks.

"To call the pearly drops from Pity's eye,
Or ſtay Deſpair's diſanimating ſigh,
Whéther, O Friend of Art! the gem you mould
Rich with new taſte, with ancient virtue bold;
Form the poor fetter'd *Slave*, on bended knee,
From Britain's ſons imploring to be free;
Or with fair HOPE the brightening ſcenes improve,
And cheer the dreary waſtes at Sydney-Cove;
Or bid Mortality rejoice and mourn
O'er the fine forms on PORTLAND's myſtic urn.—

"*Here*, by fall'n columns and disjoin'd arcades,
On mouldering ſtones, beneath deciduous ſhades,
Sits HUMANKIND in hieroglyphic ſtate,
Serious, and pondering on their changeful ſtate;
While with inverted torch, and ſwimming eyes,
Sinks the fair ſhade of *Mortal Life*, and dies.
*There* the pale *Ghoſt* through Death's wide portal bends
His timid feet, the duſky ſteep deſcends;

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*Form the poor fetter'd Slave.* l. 315. Alluding to two cameos of Mr. Wedgwood's manufacture; one of a Slave in chains, of which he diſtributed many hundreds, to excite the humane to attend to and to aſſiſt in the abolition of the deteſtable traffic in human creatures; and the other a cameo of Hope attended by Peace, and Art, and Labour; which was made of clay from Botany-Bay; to which place he ſent many of them, to ſhew the inhabitants what their materials would do, and to encourage their induſtry. A print of this latter medallion is prefixed to Mr. Stockdale's edition of Philips' Expedition to Botany-Bay, with ſome verſes which are inſerted at the end of the additional notes.

*Portland's myſtic urn.* l. 320. See additional notes, No. XXII.

With ſmiles aſſuaſive *Love Divine* invites,
Guides on broad wing, with torch uplifted lights;
*Immortal Life*, her hand extending, courts
The lingering form, his tottering ſtep ſupports;
Leads on to Pluto's realms the dreary way,
And gives him trembling to Elyſian day.
*Beneath*, in ſacred robes the PRIESTESS dreſs'd,
The coif cloſe-hooded, and the fluttering veſt,
With pointing finger guides the initiate youth,
Unweaves the many-colour'd veil of Truth,
Drives the profane from Myſtery's bolted door,
And Silence guards the Eleuſinian lore.—

"Whether, O Friend of Art! your gems derive
Fine forms from Greece, and fabled Gods revive;
Or bid from modern life the Portrait breathe,
And bind round Honour's brow the laurel wreath;
Buoyant ſhall ſail, with Fame's hiſtoric page,
Each fair medallion o'er the wrecks of age;
Nor Time ſhall mar; nor Steel, nor Fire, nor Ruſt
Touch the hard poliſh of the immortal buſt.

2. "*Hence* ſable COAL his maſſy couch extends,
And ſtars of gold the ſparkling Pyrite blends;
Hence dull-eyed Naphtha pours his pitchy ſtreams,
And Jet uncolour'd drinks the ſolar beams,
Bright Amber ſhines on his electric throne,
And adds ethereal luſtres to his own.

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*Fine forms from Greece.* l. 342. In real ſtones, or in paſte or ſoft coloured glaſs, many pieces of exquiſite workmanſhip were produced by the ancients. Baſſo-relievos of various ſizes, were made in coarſe brown earth of one colour; but of the improved kind of two or more colours, and of a true porcelain texture, none were made by the ancients, nor attempted I believe by the moderns, before thoſe of Mr. Wedgwood's manufactory.

*Hence ſable Coal.* l. 349. See additional notes, No. XXIII. on coal.

*Bright Amber ſhines.* l. 353. Coal has probably all been ſublimed more or leſs from the clay, with which it was at firſt formed in decompoſing moraſſes; the petroleum ſeems to have been ſeparated, and condenſed again in ſuperior ſtrata, and a ſtill finer kind of oil, as naphtha, has probably had the ſame origin. Some of theſe liquid oils have again loſt their more volatile parts, and become cannel-coal, aſphaltum, jet, and amber, according to the

—Led by the phoſphor-light, with daring tread
Immortal FRANKLIN ſought the fiery bed;
Where, nurſed in night, incumbent Tempeſt ſhrouds
His embryon Thunders in circumfluent clouds,
Beſieged with iron points their airy cell,
And pierced the monſters ſlumbering in the ſhell.

" So, borne on ſounding pinions to the *Weſt*,
When Tyrant-Power had built his eagle neſt;
While from his eyry ſhriek'd the famiſh'd brood,
Clenched their ſharp claws, and champ'd their beaks for blood,
Immortal FRANKLIN watch'd the callow crew,
And ſtabb'd the ſtruggling Vampires, ere they flew.
—The patriot-flame with quick contagion ran,
Hill lighted hill, and man electriſed man;
Her heroes ſlain, awhile COLUMBIA mourn'd,
And, crown'd with laurels, LIBERTY return'd.

" The Warrior, LIBERTY, with bending ſails,
Helm'd his bold courſe to fair HIBERNIA's vales;—
Firm as he ſteps along the ſhouting lands,
Lo! Truth and Virtue range their radiant bands;
Sad Superſtition wails her empire torn,
Art plies his oar, and Commerce pours her horn.

" Long had the Giant-form, on GALLIA's plains,
Inglorious ſlept, unconſcious of his chains;
Round his large limbs were wound a thouſand ſtrings
By the weak hands of Confeſſors and Kings;
O'er his cloſed eyes a triple veil was bound,
And ſteely rivets lock'd him to the ground;

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purity of the original foſſil oil. Dr. Prieſtley has ſhewn, that eſſential oils, long expoſed to the atmoſphere, abſorb both the vital and phlogiſtic part of it; whence, it is probable, their becoming ſolid may in great meaſure depend, as well as by the exhalation of their more volatile parts. On diſtillation with volatile alcali all theſe foſſil oils are ſhewn to contain the acid of amber, which evinces the identity of their origin. If a piece of amber be rubbed it attracts ſtraws and hairs, whence the diſcovery of electricity, and whence its name, from electron, the Greek word for amber.

*Immortal Franklin.* l. 356. See note on Canto I. l. 383.

While ſtern Baſtile with iron cage inthralls
His folded limbs, and hems in marble walls.
—Touch'd by the patriot-flame, he rent, amazed,
The flimſy bonds, and round and round him gazed;
Starts up from earth, above the admiring throng
Lifts his Coloſſal form, and towers along;
High o'er his foes his hundred arms He rears,
Plowſhares his ſwords, and pruning-hooks his ſpears;
Calls to the Good and Brave with voice, that rolls
Like Heaven's own thunder round the echoing poles;
Gives to the winds his banner broad unfurl'd,
And gathers in its ſhade the living world!

VII. "*Gnomes! you* then taught volcanic airs to force
Through bubbling Lavas their reſiſtleſs courſe,
O'er the broad walls of rifted Granite climb,
And pierce the rent roof of incumbent Lime;

*While ſtern Baſtile.* l. 383. "We deſcended with great difficulty into the dungeons, which were made too low for our ſtanding upright; and were ſo dark, that we were obliged at noon-day to viſit them by the light of a candle. We ſaw the hooks of thoſe chains by which the priſoners were faſtened by their necks to the walls of their cells; many of which, being below the level of the water, were in a conſtant ſtate of humidity, from which iſſued a noxious vapour, which more than once extinguiſhed the candles. Since the deſtruction of the building, many ſubterraneous cells have been diſcovered under a piece of ground, which ſeemed only a bank of ſolid earth, before the horrid ſecrets of this priſon-houſe were diſcloſed. Some ſkeletons were found in theſe receſſes, with irons ſtill faſtened to their decayed bones." Letters from France, by H. M. Williams, p. 24.

*And pierce the rent roof.* l. 398. The granite rocks and the lime-ſtone rocks have been cracked to very great depths at the time they were raiſed up by ſubterranean fires; in theſe cracks are found moſt of the metallic ores, except iron, and perhaps mangaueſe; the former of which is generally found in horizontal ſtrata, and the latter generally near the ſurface of the earth.

Philoſophers poſſeſſing ſo convenient a teſt for the diſcovery of iron by the magnet, have long ſince found it in all vegetable and animal matters; and of late Mr. Scheele has diſcovered the exiſtence of manganeſe in vegetable aſhes. Scheele, 56 mem. Stock. 1774. Kirwan. Min. 353. Which accounts for the production of it near the ſurface of the earth, and thence for its calciform appearance, or union with vital air. Bergman has likewiſe ſhewn, that the lime-ſtones which become bluiſh, or dark coloured, when calcined, poſſeſs a mixture of manganeſe, and are thence preferable, as a cement, to other kinds of lime. 2 Bergman, 229. Which impregnation with manganeſe has probably been received from the decompoſition of ſuperincumbent vegetable matters.

Theſe cracks, or perpendicular caverns, in the granite or lime-ſtone, paſs

Round ſparry caves metallic luſtres fling,
And bear Phlogiſton on their tepid wing. 400

"*Hence* glow, refulgent Tin! thy cryſtal grains,
And tawny Copper ſhoots her azure veins;
Zink lines his fretted vault with ſable ore,
And dull Galena taſſellates the floor;
On vermil beds in Idria's mighty caves 405
The living Silver rolls its ponderous waves;
With gay refractions bright Platina ſhines,
And ſtuds with ſquander'd ſtars his duſky mines;

to unknown depths; and it is up theſe channels that I have endeavoured to ſhew, that the ſteam riſes, which becomes afterwards condenſed, and produces the warm ſprings of this iſland, and other parts of the world. (See note on Fucus, vol. II.) And up theſe cracks I ſuppoſe certain vapours ariſe, which either alone, or by meeting with ſomething deſcending into them from above, have produced moſt of the metals, and ſeveral of the materials in which they are bedded. Thus the ponderous earth, Barytes, of Derbyſhire, is found in theſe cracks, and is ſtratified frequently with lead-ore, and frequently ſurrounds it. This ponderous earth has been found by Dr. Hoepfner in a granite in Switzerland, and may have thus been ſublimed from immenſe depths by great heat, and have obtained its carbonic or vitriolic acid from above. Annales de Chimie. There is alſo reaſon to conclude, that ſomething from above is neceſſary to the formation of many of the metals. At Hawkſtone, in Shropſhire, the ſeat of Sir Richard Hill, there is an elevated rock of ſiliceous ſand, which is coloured green with copper in many places high in the air; and I have in my poſſeſſion a ſpecimen of lead formed in the cavity of an iron nodule, and another of lead amid ſpar from a crack of a coal-ſtratum; all which countenance the modern production of thoſe metals from deſcending materials. To which ſhould be added, that the higheſt mountains of granite, which have, therefore, probably never been covered with marine productions, on account of their early elevation, nor with vegetable or animal matters, on account of their great coldneſs, contain no metallic ores, whilſt the lower ones contain copper and tin in their cracks or veins, both in Saxony, Sileſia, and Cornwall. Kirwan's Mineral. p. 374.

The tranſmutation of one metal into another, though hitherto undiſcovered by the alchymiſts, does not appear impoſſible; ſuch tranſmutations have been ſuppoſed to exiſt in nature; thus lapis calaminaris may have been produced from the deſtruction of lead-ore, as it is generally found on the top of the veins of lead, where it has been calcined, or united with air, and becauſe maſſes of lead-ore are often found intirely incloſed in it. So ſilver is found mixed in almoſt all lead-ores, and ſometimes in ſeparate filaments within the cavities of lead-ore, as I am informed by Mr. Michel, and is thence probably a partial tranſmutation of the lead to ſilver, the rapid progreſs of modern chemiſtry having ſhewn the analogy between metallic calces and acids, may lead to the power of tranſmuting their baſes; a diſcovery much to be wiſhed.

Long threads of netted gold, and ſilvery darts,
Inlay the Lazuli, and pierce the Quartz;—
—Whence roof'd with ſilver beam'd PERU, of old,
And hapleſs MEXICO was paved with gold.

"Heavens! on my ſight what ſanguine colours blaze!
Spain's deathleſs ſhame! the crimes of modern days!
When Avarice, ſhrouded in Religion's robe,
Sail'd to the Weſt, and ſlaughter'd half the globe;
While Superſtition, ſtalking by his ſide,
Mock'd the loud groan, and lap'd the bloody tide;
For ſacred truths announced her frenzied dreams,
And turn'd to night the ſun's meridian beams.—
Hear, Oh BRITANNIA! potent Queen of iſles,
On whom fair Art, and meek Religion ſmiles,
Now AFRIC's coaſts thy craftier ſons invade,
And Theft and Murder take the garb of Trade!
—The *Slave*, in chains, on ſupplicating knee,
Spreads his wide arms, and lifts his eyes to Thee;
With hunger pale, with wounds and toil oppreſs'd,
"*Are we not Brethren?*" ſorrow choaks the reſt;
—*Air!* bear to heaven upon thy azure flood
Their innocent cries!—*Earth!* cover not their blood!

VIII. "When Heaven's dread juſtice ſmites in crimes o'ergrown
The blood-nurſed Tyrant on his purple throne,
*Gnomes! your* bold forms unnumber'd arms outſtretch,
And urge the vengeance o'er the guilty wretch.—
Thus when CAMBYSES led his barbarous hoſts
From Perſia's rocks to Egypt's trembling coaſts,
Defiled each hallowed fane, and ſacred wood,
And, drunk with fury, ſwell'd the Nile with blood;

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*Thus when Cambyſes.* l. 435. Cambyſes marched one army from Thebes, after having overturned the temples, ravaged the country, and deluged it with blood, to ſubdue Ethiopia: this army almoſt periſhed by famine, inſomuch, that they repeatedly ſlew every tenth man to ſupply the remainder with food. He ſent another army to plunder the temple of Jupiter Ammon, which periſhed, overwhelmed with ſand.

Waved his proud banner o'er the Theban ſtates,
And pour'd deſtruction through her hundred gates;
In dread diviſions march'd the marſhal'd bands,
And ſwarming armies blacken'd all the lands,
By Memphis theſe to ETHIOP's ſultry plains,
And thoſe to HAMMON's ſand-incircled fanes.—
Slow as they paſs'd, the indignant temples frown'd,
Low curſes muttering from the vaulted ground;
Long ailes of Cypreſs waved their deepen'd glooms,
And quivering ſpectres grinn'd amid the tombs,
Prophetic whiſpers breathed from SPHINX's tongue,
And MEMNON's lyre with hollow murmurs rung;
Burſt from each pyramid expiring groans,
And darker ſhadows ſtretch'd their lengthen'd cones,
Day after day their dreadful rout They ſteer,
Luſt in the van, and Rapine in the rear,

"*Gnomes!* as they march'd, *You* hid the gather'd fruits,
The bladed graſs, ſweet grains, and mealy roots;
Scared the tired quails, that journey'd o'er their heads,
Retain'd the locuſts in their earthy beds;
Bade on your ſands no night-born dews diſtil,
Stay'd with vindictive hands the ſcanty rill.—
Loud o'er the camp the Fiend of Famine ſhrieks,
Calls all her brood, and champs her hundred beaks;
O'er ten ſquare leagues her pennons broad expand,
And twilight ſwims upon the ſhuddering ſand;
Perch'd on her creſt the Griffin Diſcord clings,
And Giant Murder rides between her wings;
Blood from each clotted hair, and horny quill,
And ſhowers of tears in blended ſtreams diſtil;

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*Expiring groans.* l. 451. Mr. Savery, or Mr. Volney, in his travels through Egypt, has given a curious deſcription of one of the pyramids, with the operoſe method of cloſing them, and immuring the body (as they ſuppoſed) for ſix thouſand years. And has endeavoured from thence to ſhew, that when a monarch died, ſeveral of his favourite courtiers were incloſed alive with the mummy in theſe great maſſes of ſtone-work; and had food and water conveyed to them, as long as they lived, proper apertures being left for this purpoſe, and for the admiſſion of air, and for the excluſion of any thing offenſive.

High-poiſed in air her ſpiry neck ſhe bends,
Rolls her keen eye, her dragon-claws extends,
Darts from above, and tears at each fell ſwoop
With iron fangs the decimated troop.

" Now o'er their heads the whizzing whirlwinds breathe,
And the live deſert pants, and heaves beneath;
Tinged by the crimſon ſun, vaſt columns riſe
Of eddying ſands, and war amid the ſkies,
In red arcades the billowy plain ſurround,
And whirling turrets ſtalk along the ground.

*And whirling turrets.* l. 478. " At one o'clock we alighted among ſome acacia trees, at Waadi el Halboub, having gone twenty-one miles. We were here at once ſurpriſed and terrified by a ſight ſurely one of the moſt magnificent in the world. In that vaſt expanſe of deſert, from W. to N. W. of us, we ſaw a number of prodigious pillars of ſand, at different diſtances, at times moving with great celerity, at others ſtalking on with a majeſtic ſlowneſs; at intervals we thought they were coming in a very few minutes to overwhelm us; and ſmall quantities of ſand did actually more than once reach us. Again they would retreat ſo as to be almoſt out of ſight, their tops reaching to the very clouds. There the tops often ſeparated from the bodies, and theſe, once disjoined, diſperſed in the air, and did not appear more. Sometimes they were broken in the middle, as if ſtruck with large cannon-ſhot. About noon they began to advance with conſiderable ſwiftneſs upon us, the wind being very ſtrong at north. Eleven of them ranged along ſide of us about the diſtance of three miles. The greateſt diameter of the largeſt appeared to me, at that diſtance, as if it would meaſure ten feet. They retired from us with a wind at S. E. leaving an impreſſion upon my mind to which I can give no name, though ſurely one ingredient in it was fear, with a conſiderable deal of wonder and aſtoniſhment. It was in vain to think of flying; the ſwifteſt horſe, or faſteſt ſailing ſhip, could be of no uſe to carry us out of this danger; and the full perſuaſion of this riveted me as if to the ſpot where I ſtood.

" The ſame appearance of moving pillars of ſand preſented themſelves to us this day in form and diſpoſition like thoſe we had ſeen at Waad Halboub, only they ſeemed to be more in number and leſs in ſize. They came ſeveral times in a direction cloſe upon us, that is, I believe, within leſs than two miles. They began immediately after ſun-riſe like a thick wood, and almoſt darkened the ſun. His rays ſhining through them for near an hour, gave them an appearance of pillars of fire. Our people now became deſperate; the Greeks ſhrieked out, and ſaid it was the day of judgment; Iſmael pronounced it to be hell; and the Turcorories, that the world was on fire." Bruce's Travels, vol. IV. p. 553—555.

From this account it would appear, that the eddies of wind were owing to the long range of broken rocks, which bounded one ſide of the ſandy deſert, and bent the currents of air, which ſtruck againſt their ſides; and were thus like the eddies in a ſtream of water which falls againſt oblique obſtacles. This explanation is probably the true one, as theſe whirl-winds were not attended with rain or lightning like the tornadoes of the Weſt-Indies.

—Long ranks in vain their ſhining blades extend,
To Demon-Gods their knees unhallow'd bend, 480
Wheel in wide circle, form in hollow ſquare,
And now they front, and now they fly the war,
Pierce the deaf tempeſt with lamenting cries,
Preſs their parch'd lips, and cloſe their blood-ſhot eyes.
—*Gnomes!* o'er the waſte *you* led your myriad powers, 485
Climb'd on the whirls, and aim'd the flinty ſhowers!—
Onward reſiſtleſs rolls the infuriate ſurge,
Clouds follow clouds, and mountains mountains urge;
Wave over wave the driving deſert ſwims,
Burſts o'er their heads, inhumes their ſtruggling limbs; 490
Man mounts on man, on camels camels ruſh,
Hoſts march o'er hoſts, and nations nations cruſh,—
Wheeling in air the winged iſlands fall,
And one great earthy Ocean covers all!—
Then ceaſed the ſtorm,—*Night* bow'd his Ethiop brow 495
To earth, and liſten'd to the groans below,—
Grim Horror ſhook,—awhile the living hill
Heaved with convulſive throes,—and all was ſtill!

IX. "*Gnomes!* whoſe fine forms, impaſſive as the air,
Shrink with ſoft ſympathy for human care; 500
Who glide unſeen, on printleſs ſlippers borne,
Beneath the waving graſs, and nodding corn;
Or lay your tiny limbs, when noon-tide warms,
Where ſhadowy cowſlips ſtretch their golden arms,—
So mark'd on orreries in lucid ſigns, 505
Star'd with bright points the mimic zodiac ſhines;
Borne on fine wires amid the pictured ſkies
With ivory orbs the planets ſet and riſe:
Round the dwarf earth the pearly moon is roll'd,
And the ſun twinkling whirls his rays of gold.— 510
Call your bright myriads, march your mailed hoſts,
With ſpears and helmets glittering round the coaſts;

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*So mark'd on orreries.* l. 505. The firſt orrery was conſtructed by a Mr. Rowley, a mathematician born at Lichfield, and ſo named from his patron, the Earl of Orrery. Johnſon's Dictionary.

Thick as the hairs, which rear the Lion's mane,
Or fringe the Boar, that bays the hunter-train;
Watch, where proud Surges break their treacherous mounds,
And ſweep reſiſtleſs o'er the cultur'd grounds; 516
Such as erewhile, impell'd o'er Belgia's plain,
Roll'd her rich ruins to the inſatiate Main;
With piles and piers the ruffian Waves engage,
And bid indignant Ocean ſtay his rage. 520

"Where, girt with clouds, the rifted Mountain yawns,
And chills with length of ſhade the gelid lawns,
Climb the rude ſteeps, the granite-cliffs ſurround,
Pierce with ſteel points, with wooden wedges wound;
Break into clays the ſoft volcanic ſlaggs, 525
Or melt with acid airs the marble craggs;
Crown the green ſummits with adventurous flocks,
And charm with novel flowers the wondering Rocks.
—So when proud Rome the Afric Warrior braved,
And high on Alps his crimſon banner waved; 530
While Rocks on Rocks their beetling brows oppoſe
With piny foreſts, and unfathom'd ſnows;
Onward he march'd, to Latium's velvet ground,
With fires and acids burſt the obdurate bound,

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*The granite-cliffs.* l. 523. On long expoſure to air, the granites or porphories of this country exhibit a ferruginous cruſt; the iron being calcined by the air, firſt becomes viſible, and is then waſhed away from the external ſurface, which becomes white or grey, and thus, in time, ſeems to decompoſe. The marbles ſeem to decompoſe by loſing their carbonic acid, as the outſide, which has been long expoſed to the air, does not ſeem to effervesce ſo haſtily with acids as the parts more recently broken. The immenſe quantity of carbonic acid, which exiſts in the many provinces of lime-ſtone, if it was extricated and decompoſed, would afford charcoal enough for fuel for ages, or for the production of new vegetable or animal bodies. The volcanic ſlaggs on Mount Veſuvius are ſaid, by Mr. Ferber, to be changed into clay by means of the ſulphur-acid, and even pots made of clay, and burnt, or vitrified, are ſaid by him to be again reducible to ductile clay, by the volcanic ſteams. Ferber's Travels through Italy, p. 166. See additional notes, No. XXIV.

*Wooden wedges wound.* l. 524. It is uſual, in ſeparating large mill-ſtones from the ſiliceous ſand rocks in ſome parts of Derbyſhire, to bore horizontal holes under them in a circle, and fill theſe with pegs made of dry wood, which gradually ſwell, by the moiſture of the earth, and, in a day or two, lift up the mill-ſtone without breaking it.

*With fires and acids.* l. 534. Hannibal was ſaid to erode his way over the Alps by fire and vinegar. The latter is ſuppoſed to allude to the vine-

Wide o'er the weeping Vales deſtruction hurl'd, 535
And ſhook the riſing empire of the world.

X. Go, gentle *Gnomes!* reſume your vernal toil,
Seek my chill tribes, which ſleep beneath the ſoil;
On grey-moſs banks, green meads, or furrow'd lands,
Spread the dark mould, white lime, and crumbling ſands;
Each burſting bud with healthier juices feed, 541
Emerging ſcion, or awaken'd ſeed.
So, in deſcending ſtreams, the ſilver Chyle
Streaks with white clouds the golden floods of Bile;
Through each nice valve the mingling currents glide, 545
Join their fine rills, and ſwell the ſanguine tide;
Each countleſs cell, and viewleſs fibre ſeek,
Nerve the ſtrong arm, and tinge the bluſhing cheek.

"Oh, watch, where boſom'd in the teeming earth,
Green ſwells the germ, impatient for its birth; 550
Guard from rapacious worms its tender ſhoots,
And drive the mining beetle from its roots;
With ceaſeleſs efforts rend the obdurate clay,
And give my vegetable babes to day!
—Thus when an Angel-form, in light array'd, 555
Like Howard pierced the priſon's noiſome ſhade;
Where chain'd to earth, with eyes to heaven upturn'd,
The kneeling Saint in holy anguiſh mourn'd;—
Ray'd from his lucid veſt, and halo'd brow,
O'er the dark roof celeſtial luſtres glow, 560
"Peter, ariſe!" with cheering voice He calls,
And ſounds ſeraphic echo round the walls;
Locks, bolts, and chains his potent touch obey,
And pleaſed he leads the exulting Sage to day.

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gar and water which was the beverage of his army. In reſpect to the former it is not improbable, but where wood was to be had in great abundance, that fires made round lime-ſtone precipices would calcine them to a conſiderable depth; the night-dews, or mountain-miſts would penetrate theſe calcined parts, and pulverize them by the force of the ſteam which the generated heat would produce, the winds would diſperſe this lime-powder, and thus, by repeated fires, a precipice of lime-ſtone might be deſtroyed, and a paſſage opened. It ſhould be added, that according to Ferber's obſervations, theſe Alps conſiſt of lime-ſtone. Letters from Italy.

XI. "*You!* whoſe fine fingers fill the organic cells 565
With virgin earth, of woods, and bones, and ſhells;
Mould with retractile glue their ſpongy beds,
And ſtretch and ſtrengthen all their fibre-threads.—
Late when the maſs obeys its changeful doom,
And ſinks to earth, its cradle and its tomb, 570
*Gnomes!* with nice eye the ſlow ſolution watch,
With foſtering hand the parting atoms catch,
Join in new forms, combine with life and ſenſe,
And guide and guard the tranſmigrating Ens.

*Mould with retractile glue.* l. 567. The conſtituent parts of animal fibres are believed to be earth and gluten. Theſe do not ſeparate except by long putrefaction or by fire. The earth then effervesces with acids, and can only be converted into glaſs by the greateſt force of fire. The gluten has continued united with the earth of the bones above 2000 years in Egyptian mummies, but by long expoſure to air or moiſture, it diſſolves, and leaves only the earth. Hence, bones long buried, when expoſed to the air, abſorb moiſture, and crumble into powder. Phil. Tranſ. No. 475. The retractibility or elaſticity of the animal fibre depends on the gluten; and of theſe fibres are compoſed the membranes, muſcles, and bones. Haller. Phyſiol. Tom. I. p. 2.

For the chemical decompoſition of animal and vegetable bodies, ſee the ingenious work of Lavoiſier, Traité de Chimie, Tom. I. p. 132. who reſolves all their component parts into oxygene, hydrogene, carbone, and azote; the three former of which belong principally to vegetable, and the laſt to animal matter.

*The tranſmigrating Ens.* l. 574. The perpetual circulation of matter, in the growth and diſſolution of vegetable and animal bodies, ſeems to have given Pythagoras his idea of the metempſycoſis, or tranſmigration of ſpirit, which was afterwards dreſſed out, or ridiculed, in a variety of amuſing fables. Other philoſophers have ſuppoſed, that there are two different materials or eſſences, which fill the univerſe. One of theſe, which has the power of commencing or producing motion, is called ſpirit; the other, which has the power of receiving and of communicating motion, but not of beginning it, is called matter. The former of theſe is ſuppoſed to be diffuſed through all ſpace, filling up the interſtices of the ſuns and planets, and conſtituting the gravitations of the ſidereal bodies, the attractions of chemiſtry, with the ſpirit of vegetation, and of animation. The latter occupies comparatively but ſmall ſpace, conſtituting the ſolid parts of the ſuns and planets, and their atmoſpheres. Hence theſe philoſophers have ſuppoſed, that both matter and ſpirit are equally immortal and unperiſhable; and that, on the diſſolution of vegetable or animal organization, the matter returns to the general maſs of matter, and the ſpirit to the general maſs of ſpirit, to enter again into new combinations, according to the original idea of Pythagoras.

The ſmall apparent quantity of matter that exiſts in the univerſe, compared to that of ſpirit, and the ſhort time in which the recrements of animal or vegetable bodies become again vivified in the forms of vegetable mucor or microſcopic inſects, ſeems to have given riſe to another curious fable of antiquity; that Jupiter threw down a large handful of ſouls upon the earth, and left them to ſcramble for the few bodies which were to be had.

"So when on Lebanon's ſequeſter'd height
The fair Adonis left the realms of light,
Bow'd his bright locks, and, fated from his birth
To change eternal, mingled with the earth;—
With darker horror ſhook the conſcious wood,
Groan'd the ſad gales, and rivers bluſh'd with blood;
On cypreſs-boughs the Loves their quivers hung,
Their arrows ſcatter'd, and their bows unſtrung;
And *Beauty's Goddeſs*, bending o'er his bier,
Breathed the ſoft ſigh, and pour'd the tender tear.—
Admiring *Proſerpine* through duſky glades
Led the fair phantom to Elyſian ſhades,
Clad with new form, with finer ſenſe combined,
And lit with purer flame the ethereal mind.
—Erewhile, emerging from infernal night,
The bright Aſſurgent riſes into light,
Leaves the drear chambers of the inſatiate tomb,
And ſhines and charms with renovated bloom.—
While wondering Loves the burſting grave ſurround,
And edge with meeting wings the yawning ground,
Stretch their fair necks, and leaning o'er the brink,
View the pale regions of the dead, and ſhrink;
Long with broad eyes ecſtatic *Beauty* ſtands,
Heaves her white boſom, ſpreads her waxen hands;

*Adonis.* l. 576. The very ancient ſtory of the beautiful Adonis paſſing one half of the year with Venus, and the other with Proſerpine, alternately, has had variety of interpretations. Some have ſuppoſed that it allegorized the ſummer and winter ſolſtice; but this ſeems too obvious a fact to have needed an hieroglyphic emblem. Others have believed it to repreſent the corn, which was ſuppoſed to ſleep in the earth during the winter months, and to riſe out of it in ſummer. This does not accord with the climate of Egypt, where the harveſt ſoon follows the ſeed-time.

It ſeems more probably to have been a ſtory explaining ſome hieroglyphic figures repreſenting the decompoſition and reſuſcitation of animal matter; a ſublime and intereſting ſubject, and which ſeems to have given origin to the doctrine of tranſmigration, which had probably its birth alſo from the hieroglyphic treaſures of Egypt. It is remarkable that the cypreſs groves, in the ancient Greek writers, as in Theocritus, were dedicated to Venus, and afterwards became funeral emblems. Which was probably occaſioned by the Cypreſs being an accompaniment of Venus in the annual proceſſions, in which ſhe was ſuppoſed to lament over the funeral of Adonis; a ceremony which obtained over all the eaſtern world from great antiquity, and is ſuppoſed to be referred to by Ezekiel, who accuſes the idolatrous woman of weeping for Thammuz.

Then with loud ſhriek the panting Youth alarms,
"My Life! my Love!" and ſprings into his arms."

The *Goddeſs* ceaſed,—the delegated throng
O'er the wide plains delighted ruſh along;
In duſky ſquadrons, and in ſhining groups,
Hoſts follow hoſts, and troops ſucceed to troops;
Scarce bears the bending graſs the moving freight,
And nodding florets bow beneath their weight.
So when light clouds on airy pinions ſail,
Flit the ſoft ſhadows o'er the waving vale;
Shade follows ſhade, as laughing Zephyrs drive,
And all the chequer'd landſcape ſeems alive.

*Zephyrs drive.* l. 609. Theſe lines were originally written thus,

> Shade follows ſhade by laughing Zephyrs drove,
> And all the chequer'd landſcape ſeems to move;

but were altered on account of the ſuppoſed falſe grammar in uſing the word drove for driven, according to the opinion of Dr. Lowth: at the ſame time it may be obſerved, 1. That this is, in many caſes, only an ellipſis of the letter *n* at the end of the word, as froze for frozen, weve for woven, ſpoke for ſpoken, and that then the participle accidentally becomes ſimilar to the paſt tenſe: 2. That the language ſeems gradually tending to omit the letter *n* in other kind of words, for the ſake of euphony; as houſen is become houſes, eyne eyes, thine thy, &c. and, in common converſation, the words forgot, ſpoke, froze, rode, are frequently uſed for forgotten, ſpoken, frozen, ridden. 3. It does not appear that any confuſion would follow the indiſcriminate uſe of the ſame word for the paſt tenſe and the participle paſſive, ſince the auxiliary verb *have*, or the preceding noun or pronoun, always clearly diſtinguiſhes them: and, laſtly, rhime-poetry muſt loſe the uſe of many elegant words without this licenſe.

# ARGUMENT

## OF THE

## THIRD CANTO.

ADDRESS to the Nymphs. I. Steam riſes from the ocean, floats in clouds, deſcends in rain and dew, or is condenſed on hills, produces ſprings, and rivers, and returns to the ſea. So the blood circulates through the body and returns to the heart, 11. II. 1. Tides, 57. 2. Echinus, nautilus, pinna, cancer. Grotto of a mermaid, 65. 3. Oil ſtills the waves. Coral rocks. Ship-worm, or Teredo. Maelſtrome, a whirlpool on the coaſt of Norway, 85. III. Rivers from beneath the ſnows on the Alps. The Tiber, 103. IV. Overflowing of the Nile from African Monſoons, 129. V. 1. Gieſar, a boiling fountain in Iceland, deſtroyed by inundation, and conſequent earthquake, 145. 2. Warm medicinal ſprings. Buxton. Duke and Ducheſs of Devonſhire, 157. VI. Combination of vital air and inflammable gas produces water. Which is another ſource of ſprings and rivers. Allegorical loves of Jupiter and Juno productive of vernal ſhowers, 201. VII. Aquatic Taſte. Diſtant murmur of the ſea by night. Sea-horſe. Nereid ſinging, 261. VIII. The Nymphs of the river Derwent lament the death of Mrs. French, 297. IX. Inland navigation. Monument for Mr. Brindley, 341. X. Pumps explained. Child ſucking. Mothers exhorted to nurſe their children. Cherub ſleeping, 365. XI. Engines for extinguiſhing fire. Story of two lovers periſhing in the flames, 397. XII. Charities of Miſs Jones, 447. XIII. Marſhes drained. Hercules conquers Achelous. The horn of plenty, 483. XIV. Showers. Dews. Floating lands with water. Lacteal ſyſtem in animals. Caravan drinking, 529. Departure of the Nymphs like water-ſpiders; like northern nations ſkaiting on the ice, 569.

# THE
# BOTANIC GARDEN.

## ECONOMY OF VEGETATION.

### CANTO III.

AGAIN the *Goddeſs* ſpeaks! glad Echo ſwells
The tuneful tones along her ſhadowy dells,
Her wrinkling founts with ſoft vibration ſhakes,
Curls her deep wells, and rimples all her lakes,
Thrills each wide ſtream, Britannia's iſle that laves,
Her headlong cataracts, and circumfluent waves.
—Thick as the dews, which deck the morning flowers,
Or rain-drops twinkling in the ſun-bright ſhowers,
Fair Nymphs, emerging in pellucid bands,
Riſe, as ſhe turns, and whiten all the lands.

I. " *Your* buoyant troops on dimpling ocean tread,
Wafting the moiſt air from his oozy bed,
*Aquatic Nymphs!*—*you* lead with viewleſs march
The winged Vapours up the aerial arch,
On each broad cloud a thouſand ſails expand,
And ſteer the ſhadowy treaſure o'er the land;

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*The winged vapours.* l. 14. See additional notes, No. XXV. on evaporation.

*On each broad cloud.* l. 15. The clouds conſiſt of condenſed vapour, the particles of which are too ſmall ſeparately to overcome the tenacity of the air, and which, therefore, do not deſcend. They are in ſuch ſmall ſpheres as to repel each other; that is, they are applied to each other by ſuch very ſmall ſurfaces, that the attraction of the particles of each drop to its own centre, is greater than its attraction to the ſurface of the drop in its vicinity

Through vernal ſkies the gathering drops diffuſe,
Plunge in ſoft rains, or ſink in ſilver dews.—
*Your* lucid bands condenſe with fingers chill
The blue miſt hovering round the gelid hill; 20

every one has obſerved with what difficulty ſmall ſpherules of quickſilver can be made to unite, owing to the ſame cauſe; and it is common to ſee, on riding through ſhallow water on a clear day, numbers of very ſmall ſpheres of water, as they are thrown from the horſes feet, run along the ſurface for many yards before they again unite with it. In many caſes theſe ſpherules of water, which compoſe clouds, are kept from uniting by a ſurplus of electric fluid, and fall, in violent ſhowers, as ſoon as that is withdrawn from them, as in thunder ſtorms. See note on Canto I. l. 554.

If, in this ſtate, a cloud becomes frozen, it is torn to pieces in its deſcent, by the friction of the air, and falls in white flakes of ſnow. Or theſe flakes are rounded by being rubbed together by the winds, and by having their angles thawed off by the warmer air beneath as they deſcend; and part of the water produced by theſe angles, thus diſſolved, is abſorbed into the body of the hail-ſtone, as may be ſeen by holding a lump of ſnow over a candle, and there becomes frozen into ice, by the quantity of cold which the hailſtone poſſeſſes beneath the freezing point, or which is produced by its quick evaporation in falling; and thus hail-ſtones are often found of greater or leſs denſity, according as they conſiſt of a greater portion of ſnow or ice. If hail-ſtones conſiſted of the large drops of ſhowers frozen in their deſcent, they would conſiſt of pure tranſparent ice.

As hail is only produced in ſummer, and is always attended with ſtorms, ſome philoſophers have believed, that the ſudden departure of electricity from a cloud may effect ſomething yet unknown in this phenomenon; but it may happen in ſummer independent of electricity, becauſe aqueous vapour is then raiſed higher in the atmoſphere, whence it has further to fall, and there is warmer air below for it to fall through.

*Or ſink in ſilver dews.* l. 18. During the coldneſs of the night the moiſture before diſſolved in the air is gradually precipitated, and, as it ſubſides, adheres to the bodies it falls upon. Where the attraction of the body to the particles of water is greater than the attractions of thoſe particles to each other, it becomes ſpread upon their ſurface, or ſlides down them in actual contact, as on the broad parts of the blades of moiſt graſs. Where the attraction of the ſurface to the water is leſs than the attraction of the particles of water to each other, the dew ſtands in drops, as on the points and edges of graſs or gorſe, where the ſurface preſented to the drop being ſmall, it attracts it ſo little as but juſt to ſupport it without much changing its globular form. Where there is no attraction between the vegetable ſurface and the dew drops, as on cabbage leaves, the drop does not come into contact with the leaf, but hangs over it repelled, and retains its natural form, compoſed of the attraction and preſſure of its own parts, and thence looks like quickſilver, reflecting light from both its ſurfaces. Nor is this owing to any oilineſs of the leaf, but ſimply to the poliſh of its ſurface, as a light needle may be laid on water in the ſame manner without touching it; for as the attractive powers of poliſhed ſurfaces are greater when in actual contact, ſo the repulſive power is greater before contact.

*The blue miſt.* l. 20. Miſts are clouds reſting on the ground; they generally come on at the beginning of night, and either fill the moiſt vallies, or hang on the ſummits of hills, according to the degree of moiſture previouſly

In clay-form'd beds the trickling ſtreams collect,
Strain through white ſands, through pebbly veins direct;
Or point in rifted rocks their dubious way,
And in each bubbling fountain riſe to day.

"*Nymphs! you* then guide, attendant from their ſource,
The aſſociate rills along their ſinuous courſe; 26
Float in bright ſquadrons by the willowy brink,
Or circling flow in limpid eddies ſink;
Call from her cryſtal cave the Naiad-Nymph,
Who hides her fine form in the paſſing lymph, 30
And, as below ſhe braids her hyaline hair,
Eyes her ſoft ſmiles reflected in the air;
Or ſport in groups with River-Boys, that lave
Their ſilken limbs amid the daſhing wave;
Pluck the pale primroſe bending from its edge, 35
Or tittering dance amid the whiſpering ſedge.—

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diſſolved, and the eduction of heat from them. The air over rivers, during the warmth of the day, ſuſpends much moiſture; and, as the changeful ſurface of rivers occaſions them to cool ſooner than the land, at the approach of evening, miſts are moſt frequently ſeen to begin over rivers, and to ſpread themſelves over moiſt grounds, and fill the vallies, while the miſts on the tops of mountains are more properly clouds, condenſed by the coldneſs of their ſituation.

On aſcending up the ſide of a hill from a miſty valley, I have obſerved a beautiful coloured halo round the moon, when a certain thickneſs of miſt was over me, which ceaſed to be viſible as ſoon as I emerged out of it; and well remember admiring, with other ſpectators, the ſhadow of the three ſpires of the cathedral church at Lichfield, the moon riſing behind it, apparently broken off, and lying diſtinctly over our heads, as if horizontally on the ſurface of the miſt, which aroſe about as high as the roof of the church. There are ſome curious remarks on ſhadows, or reflections ſeen on the ſurface of miſts from high mountains, in Ulloa's Voyages. The dry miſt of ſummer 1783, was probably occaſioned by volcanic eruption, as mentioned in note on Chunda, vol. II. and, therefore, more like the atmoſphere of ſmoke, which hangs, on ſtill days, over great cities.

There is a dry miſt, or rather a diminiſhed tranſparence of the air, which, according to Mr. Sauſſure, accompanies fair weather, while great tranſparence of air indicates rain. Thus when large rivers, two miles broad, ſuch as at Liverpool, appear narrow, it is ſaid to prognoſticate rain, and when wide, fair weather. This want of tranſparence of the air, in dry weather, may be owing to new combinations or decompoſitions of the vapours diſſolved in it, but wants further inveſtigation. Eſſais ſur L'Hygrometrie, p. 357.

*Round the gelid hill.* ib. See additional notes, No. XXVI. on the origin of ſprings.

" Onward *you* paſs, the pine-capt hills divide,
Or feed the golden harveſts on their ſide;
The wide-ribb'd arch with hurrying torrents fill,
Shove the ſlow barge, or whirl the foaming mill.
*Or* lead with beckoning hand the ſparkling train
Of refluent water to its parent main,
And pleaſed reviſit in their ſea-moſs vales
Blue Nereid-forms array'd in ſhining ſcales,
Shapes, whoſe broad oar the torpid wave impels,
And Tritons bellowing through their twiſted ſhells.

" So from the heart the Sanguine Stream diſtils
O'er Beauty's radiant ſhrine in vermil rills,
Feeds each fine nerve, each ſlender hair pervades,
The ſkin's bright ſnow with living purple ſhades,
Each dimpling cheek with warmer bluſhes dyes,
Laughs on the lips, and lightens in the eyes.
—Erewhile abſorb'd, the vagrant globules ſwim
From each fair feature, and proportion'd limb,
Join'd in one trunk with deeper tint return
To the warm concave of the vital urn.

II. 1. " *Aquatic Maids! you* ſway the mighty realms
Of ſcale and ſhell, which Ocean overwhelms;
As Night's pale Queen her riſing orb reveals,
And climbs the zenith with refulgent wheels,
Carr'd on the foam your glimmering legion rides,
Your little tridents heave the daſhing tides,

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*Carr'd on the foam.* l. 61. The phenomena of the tides have been well inveſtigated, and ſatisfactorily explained, by Sir Iſaac Newton and Dr. Halley, from the reciprocal gravitations of the earth, moon, and ſun. As the earth and moon move round a centre of motion near the earth's ſurface, at the ſame time that they are proceeding in their annual orbit round the ſun, it follows, that the water on the ſide of the earth neareſt this centre of motion, between the earth and moon, will be more attracted by the moon, and the waters on the oppoſite ſide of the earth will be leſs attracted by the moon, than the central parts of the earth. Add to this, that the centrifugal force of the water on the ſide of the earth furtheſt from the centre of the motion, round which the earth and moon move, (which, as was ſaid before, is near the ſurface of the earth,) is greater than that on the oppoſite ſide of the earth. From both theſe cauſes it is eaſy to comprehend, that the water will riſe on two ſides of the earth, viz. on that neareſt to the

Urge on the ſounding ſhores their cryſtal courſe,
Reſtrain their fury, or direct their force.

2. " *Nymphs! you* adorn, in gloſſy volutes roll'd, 65
The gaudy conch with azure, green, and gold.

moon, and its oppoſite ſide, and that it will be flattened, in conſequence, at the quadratures, and thus produce two tides in every lunar day, which conſiſts of about twenty-four hours and forty-eight minutes.

Theſe tides will be alſo affected by the ſolar attraction when it coincides with the lunar one, or oppoſes it, as at new and full moon, and will alſo be much influenced by the oppoſing ſhores in every part of the earth.

Now, as the moon, in moving round the centre of gravity between itſelf and the earth, deſcribes a much larger orbit than the earth deſcribes round the ſame centre, it follows, that the centrifugal motion of the ſide of the moon oppoſite to the earth muſt be much greater than the centrifugal motion of the ſide of the earth oppoſite to the moon, round the ſame centre. And, ſecondly, as the attraction of the earth exerted on the moon's ſurface next to the earth, is much greater than the attraction of the moon exerted on the earth's ſurface, the tides on the lunar ſea (if ſuch there be) ſhould be much greater than thoſe of our ocean. Add to this, that as the ſame face of the moon always is turned to the earth, the lunar tides muſt be permanent, and if the ſolid parts of the moon be ſpherical, muſt always cover the phaſis next to us. But as there are evidently hills, and vales, and volcanos, on this ſide of the moon, the conſequence is, that the moon has no ocean, or that it is frozen.

*The gaudy conch*. l. 66. The ſpiral form of many ſhells ſeem to have afforded a more frugal manner of covering the long tail of the fiſh with calcareous armour; ſince a ſingle thin partition between the adjoining circles of the fiſh was ſufficient to defend both ſurfaces, and thus much cretaceous matter is ſaved; and it is probable, that from this ſpiral form they are better enabled to feel the vibrations of the element in which they exiſt. See note on Canto IV. l. 162. This cretaceous matter is formed by a mucous ſecretion from the ſkin of the fiſh, as is ſeen in crab-fiſh, and others which annually caſt their ſhells, and is at firſt a mucous covering (like that of a hen's egg, when it is laid a day or two too ſoon) and which gradually hardens. This may alſo be ſeen in common ſhell ſnails; if a part of their ſhell be broken, it becomes repaired in a ſimilar manner with mucus, which, by degrees, hardens into ſhell.

It is probable the calculi, or ſtones found in other animals, may have a ſimilar origin, as they are formed on mucous membranes, as thoſe of the kidney and bladder, chalk-ſtones in the gout, and gall-ſtones; and are probably owing to the inflammation of the membrane where they are produced, and vary according to the degree of inflammation of the membrane which forms them, and the kind of mucus which it naturally produces. Thus the ſhelly matter of different ſhell-fiſh differs, from the coarſer kinds, which form the ſhells of crabs, to the finer kinds, which produce the mother-pearl.

The beautiful colours of ſome ſhells originate from the thinneſs of the laminæ of which they conſiſt, rather than to any colouring matter, as is ſeen in mother-pearl, which reflects different colours according to the obliquity of the light which falls on it. The beautiful priſmatic colours ſeen on the Labradore ſtone, are owing to a ſimilar cauſe, viz. the thinneſs of the laminæ of which it conſiſts, and has probably been formed from mother-pearl ſhells.

*You* round Echinus ray his arrowy mail,
Give the keel'd Nautilus his oar and ſail;
Firm to his rock with ſilver cords ſuſpend
The anchor'd Pinna, and his Cancer-friend;
With worm-like beard his toothleſs lips array,
And teach the unwieldy Sturgeon to betray.—
Ambuſh'd in weeds, or ſepulchred in ſands,
In dread repoſe He waits the ſcaly bands,
Waves in red ſpires the living lures, and draws
The unwary plunderers to his circling jaws,
Eyes with grim joy the twinkling ſhoals beſet,
And claſps the quick inextricable net.
*You* chaſe the warrior Shark, and cumberous Whale,
And guard the Mermaid in her briny vale;
Feed the live petals of her inſect-flowers,
Her ſhell-wrack gardens, and her ſea-fan bowers;
With ores and gems adorn her coral cell,
And drop a pearl in every gaping ſhell.

It is curious that ſome of the moſt common foſſil ſhells are not now known in their recent ſtate, as the cornua ammonis; and, on the contrary, many ſhells which are very plentiful in their recent ſtate, as limpets, ſea-ears, volutes, cowries, are very rarely found foſſil. Da Coſta's Conchology, p. 163. Were all the ammoniæ deſtroyed when the continents were raiſed? Or do ſome genera of animals periſh by the increaſing power of their enemies? Or do they ſtill reſide at inacceſſible depths in the ſea? Or do ſome animals change their form gradually, and become new genera?

*Echinus. Nautilus.* l. 67, 68. See additional notes, No. XXVII.

*Pinna. Cancer.* l. 70. See additional notes, No. XXVII.

*With worm-like beard.* l. 71. See additional notes, No. XXVIII.

*Feed the live petals.* l. 81. There is a ſea-inſect, deſcribed by M. Huges, whoſe claws, or tentacles, being diſpoſed in regular circles, and tinged with variety of bright lively colours, repreſent the petals of ſome moſt elegantly fringed and radiated flowers, as the carnation, marigold, and anemone. Philoſ. Tranſ. Abridg. vol. IX. p. 110. The Abbe Dicquemarre has further elucidated the hiſtory of the actinia, and obſerved their manner of taking their prey by incloſing it in theſe beautiful rays like a net. Phil. Tranſ. vol. LXIII. and LXV. and LXVII.

*And drop a pearl.* l. 84. Many are the opinions both of ancient and modern writers concerning the production of pearls. Mr. Reaumur thinks they are formed like the hard concretions in many land animals, as ſtones of the bladder, gall-ſtones, and bezoar, and hence concludes them to be a diſeaſe of the fiſh; but there ſeems to be a ſtricter analogy between theſe and the calcareous productions found in crab-fiſh, called crab's eyes, which are formed near the ſtomach of the animal, and conſtitute a reſervoir of calcareous matter againſt the renovation of the ſhell, at which time they are

3. “ *Your* myriad trains o'er ſtagnant oceans tow,
Harneſs'd with goſſamer, the loitering prow;
Or with fine films, ſuſpended o'er the deep,
Of oil effuſive lull the waves to ſleep.
*You* ſtay the flying bark, conceal'd beneath,
Where living rocks of worm-built coral breathe;
Meet fell TEREDO, as he mines the keel
With beaked head, and break his lips of ſteel;
Turn the broad helm, the fluttering canvas urge
From MAELSTROME's fierce innavigable ſurge.
—'Mid the lorn iſles of Norway's ſtormy main,
As ſweeps o'er many a league his eddying train,
Vaſt watery walls in rapid circles ſpin,
And deep-ingulph'd the Demon dwells within;
Springs o'er the fear-froze crew with harpy-claws,
Down his deep den the whirling veſſel draws;
Churns with his bloody mouth the dread repaſt,
The booming waters murmuring o'er the maſt.

III. “ Where with chill frown enormous Alps alarms
A thouſand realms, horizon'd in his arms;
While cloudleſs ſuns meridian glories ſhed
From ſkies of ſilver round his hoary head,

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re-diſſolved, and depoſited for that purpoſe. As the internal part of the ſhell of the pearl, oyſter, or muſcle, conſiſts of mother-pearl, which is a ſimilar material to the pearl, and, as the animal has annually occaſion to enlarge his ſhell, there is reaſon to ſuſpect the looſe pearls are ſimilar reſervoirs of the pearly matter for that purpoſe.

*Or with fine films.* l. 87. See additional notes, No. XXIX.

*Where living rocks.* l. 90. The immenſe and dangerous rocks built by the ſwarms of coral inſects, which riſe almoſt perpendicularly in the ſouthern ocean, like walls, are deſcribed in Cook's Voyages; a point of one of theſe rocks broke off, and ſtuck in the hole which it had made in the bottom of one of his ſhips, which would otherwiſe have periſhed by the admiſſion of water. The numerous lime-ſtone rocks, which conſiſt of a congeries of the cells of theſe animals, and which conſtitute a great part of the ſolid earth, ſhew their prodigious multiplication in all ages of the world. Specimens of theſe rocks are to be ſeen in the lime-works at Linſel, near Newport, in Shropſhire, in Coal-brook Dale, and in many parts of the Peak of Derbyſhire. The inſect has been well deſcribed by M. Peyſonnel, Ellis, and others. Phil. Tranſ. vol. XLVII. L. LII. and LVII.

*Meet fell Teredo.* l. 91. See additional notes, No. XXX.

*Turn the broad helm.* l. 93. See additional notes, No. XXXI.

Tall rocks of ice refract the coloured rays,
And Froſt ſits throned amid the lambent blaze;
*Nymphs! your* thin forms pervade his glittering piles,
His roofs of chryſtal, and his glaſſy ailes;
Where in cold caves impriſoned Naiads ſleep,
Or chain'd on moſſy couches wake and weep;
Where round dark crags indignant Waters bend
Through rifted ice, in ivory veins deſcend,
Seek through unfathom'd ſnows their devious track,
Heave the vaſt ſpars, the ribbed granites crack,
Ruſh into day, in foamy torrents ſhine,
And ſwell the imperial Danube or the Rhine.—

*Where round dark crags.* l. 113. See additional notes, No. XXXII.

*Heave the vaſt ſpars.* l. 116. Water, in deſcending down elevated ſituations, if the outlet for it below is not ſufficient for its emiſſion, acts with a force equal to the height of the column, as is ſeen in an experimental machine called the philoſophical bellows, in which a few pints of water are made to raiſe many hundred pounds. To this cauſe is to be aſcribed many large promontories of ice being occaſionally thrown down from the glaciers; rocks have likewiſe been thrown from the ſides of mountains by the ſame cauſe, and large portions of earth have been removed many hundred yards from their ſituations at the foot of mountains. On inſpecting the locomotion of about thirty acres of earth, with a ſmall houſe, near Bilder's Bridge, in Shropſhire, about twenty years ago, from the foot of a mountain towards the river, I well remember, it bore all the marks of having been thus lifted up, puſhed away, and, as it were, crumpled into ridges, by a column of water contained in the mountain.

From water being thus confined in high columns, between the ſtrata of mountainous countries, it has often happened, when wells or perforations have been made into the earth, that ſprings have ariſen much above the ſurface of the new well. When the new bridge was building at Dublin, Mr. G. Semple found a ſpring in the bed of the river where he meant to lay the foundation of a pierre, which, by fixing iron pipes into it, he raiſed many feet. Treatiſe on Building in Water, by G. Semple. From having obſerved a valley north-weſt of St. Alkmond's well, near Derby, at the head of which that ſpring of water once probably exiſted, and by its current formed the valley, (but which, in after times, found its way out in its preſent ſituation,) I ſuſpect that St. Alkmond's well might, by building round it, be raiſed high enough to ſupply many ſtreets in Derby with ſpring-water, which are now only ſupplied with river-water. See an account of an artificial ſpring of water, Phil. Tranſ. vol. LXXV. p. 1.

In making a well at Sheerneſs the water roſe 300 feet above its ſource in the well. Phil. Tranſ. vol. LXXIV. And at Hartford, in Connecticut, there is a well which was dug ſeventy feet deep before water was found; then, in boring an auger-hole through a rock, the water roſe ſo faſt as to make it difficult to keep it dry by pumps, till they could blow the hole larger by gun-powder, which was no ſooner accompliſhed than it filled, and run over, and has been a brook for near a century. Travels through America. Lond. 1789. Lane.

—Or feed the murmuring Tiber, as he laves
His realms inglorious with diminiſh'd waves,
Hears his lorn Forum ſound with Eunuch-ſtrains,
Sees dancing ſlaves inſult his martial plains;
Parts with chill ſtream the dim religious bower,
Time-mouldered baſtion, and diſmantled tower;
By alter'd fanes and nameleſs villas glides,
And claſſic domes, that tremble on his ſides;
Sighs o'er each broken urn, and yawning tomb,
And mourns the fall of Liberty and Rome.

IV. "Sailing in air, when dark *Monſoon* inſhrouds
His tropic mountains in a night of clouds;
Or drawn by whirlwinds from the Line returns,
And ſhowers o'er Afric all his thouſand urns;
High o'er his head the beams of Sirius glow,
And, Dog of Nile, Anubis, barks below.
*Nymphs! you* from cliff to cliff attendant guide,
In headlong cataracts the impetuous tide;
Or lead o'er waſtes of Abyſſinian ſands
The bright expanſe to Egypt's ſhower-leſs lands.

*Dark Monſoon inſhrouds.* l. 129. When from any peculiar ſituations of land, in reſpect to ſea, the tropic becomes more heated, when the ſun is vertical over it, than the line, the periodical winds, called monſoons, are produced, and theſe are attended by rainy ſeaſons; for as the air at the tropic is now more heated than at the line, it aſcends by decreaſe of its ſpecific gravity, and floods of air ruſh in both from the ſouth-weſt and north-eaſt, and theſe being one warmer than the other, the rain is precipitated by their mixture, as obſerved by Dr. Hutton. See additional notes, No. XXV. All late travellers have aſcribed the riſe of the Nile to the monſoons which deluge Nubia and Abyſſinia with rain. The whirling of the aſcending air was even ſeen by Mr. Bruce in Abyſſinia: he ſays, "Every morning a ſmall cloud began to whirl round, and preſently after the whole heavens became covered with clouds." By this vortex of aſcending air the N. E. winds and the S. W. winds, which flow in to ſupply the place of the aſcending column, became mixed more rapidly, and depoſited their rain in greater abundance.

Mr. Volney obſerves, that the time of the riſing of the Nile commences about the 19th of June; and that Abyſſinia and the adjacent parts of Africa are deluged with rain in May, June, and July, and produce a maſs of water which is three months in draining off. The Abbe Le Pluche obſerves, that as Sirius, or the dog-ſtar, roſe at the time of the commencement of the flood, its riſing was watched by the aſtronomers, and notice given of the approach of inundation, by hanging the figure of Anubis, which was that of a man with a dog's head, upon all their temples. Hiſtoire de Ciel.

*Egypt's ſhower-leſs lands.* l. 138. There ſeem to be two ſituations which

—Her long canals the ſacred waters fill,
And edge with ſilver every peopled hill; 140
Gigantic SPHINX in circling waves admire,
And MEMNON bending o'er his broken lyre;
O'er furrow'd glebes and green ſavannas ſweep,
And towns and temples laugh amid the deep.

V. 1. "High in the frozen North where HECLA glows,
And melts in torrents his coeval ſnows; 146
O'er iſles and oceans ſheds a ſanguine light,
Or ſhoots red ſtars amid the ebon night;
When, at his baſe intomb'd, with bellowing ſound
Fell GIESAR roar'd, and, ſtruggling, ſhook the ground; 150
Pour'd from red noſtrils, with her ſcalding breath,
A boiling deluge o'er the blaſted heath;

may be conceived to be exempted from rain falling upon them; one where the conſtant trade-winds meet beneath the line, for here two regions of warm air are mixed together, and thence do not ſeem to have any cauſe to precipitate their vapour; and the other is, where the winds are brought from colder climates and become warmer by their contact with the earth of a warmer one. Thus Lower Egypt is a flat country warmed by the ſun more than the higher lands on one ſide of it, and than the Mediterranean on the other; and hence the winds which blow over it acquire greater warmth, which ever way they come, than they poſſeſſed before, and in conſequence have a tendency to acquire and not to part with their vapour, like the north-eaſt winds of this country. There is ſaid to be a narrow ſpot upon the coaſt of Peru, where rain ſeldom occurs; at the ſame time, according to Ulloa, on the mountainous regions of the Andes, beyond, there is almoſt perpetual rain. For the wind blows uniformly upon this hot part of the coaſt of Peru, but no cauſe of devaporation occurs till it begins to aſcend the mountainous Andes, and then its own expanſion produces cold ſufficient to condenſe its vapour.

*Fell Gieſar roar'd.* l. 150. The boiling column of water at Gieſar in Iceland, was nineteen feet in diameter, and ſometimes roſe to the height of ninety-two feet. On cooling, it depoſited a ſiliceous matter, or chalcedony, forming a baſon round its baſe. The heat of this water before it roſe out of the earth could not be aſcertained, as water loſes all its heat above 212 (as ſoon as it is at liberty to expand) by the exhalation of a part; but the flinty baſon which is depoſited from it ſhews that water, with great degrees of heat, will diſſolve ſiliceous matter. Van Troil's Letters on Iceland. Since the above account, in the year 1780, this part of Iceland has been deſtroyed by an earthquake, or covered with lava, which was probably effected by the force of aqueous ſteam, a greater quantity of water falling on the ſubterraneous fires than could eſcape by the ancient outlets, and generating an increaſed quantity of vapour. For the diſperſion of contagious vapours from volcanos, ſee an account of the Harmattan, in the notes on Chunda, vol. II.

And, wide in air, in miſty volumes hurl'd
Contagious atoms o'er the alarmed world;
*Nymphs! your* bold myriads broke the infernal ſpell, 155
And cruſh'd the Sorcereſs in her flinty cell.

2. "Where with ſoft fires in unextinguiſh'd urns,
Cauldron'd in rock, innocuous Lava burns;
On the bright lake *your* gelid hands diſtil
In pearly ſhowers the parſimonious rill; 160
And, as aloft the curling vapours riſe
Through the cleft roof, ambitious for the ſkies,
In vaulted hills condenſe the tepid ſteams,
And pour to *Health* the medicated ſtreams.
—So in green vales amid her mountains bleak 165
BUXTONIA ſmiles, the Goddeſs-Nymph of Peak;
Deep in warm waves, and pebbly baths ſhe dwells,
And calls HYGEIA to her ſainted wells.

"Hither in ſportive bands bright DEVON leads
Graces and Loves from Chatſworth's flowery meads. 170
Charm'd round the *Nymph*, they climb the rifted rocks;
And ſteep in mountain-miſt their golden locks;
On venturous ſtep her ſparry caves explore,
And light with radiant eyes her realms of ore:
—Oft by her bubbling founts, and ſhadowy domes, 175
In gay undreſs the fairy legion roams,
Their dripping palms in playful malice fill,
Or taſte with ruby lip the ſparkling rill;
Croud round her baths, and, bending o'er the ſide,
Unclaſp'd their ſandals, and their zones untied, 180
Dip with gay fear the ſhuddering foot undreſs'd,
And quick retract it to the fringed veſt;

*Buxtonia ſmiles*. l. 166. Some arguments are mentioned in the note on Fucus, vol. II. to ſhew that the warm ſprings of this country do not ariſe from the decompoſition of pyrites near the ſurface of the earth, but that they are produced by ſteam riſing up the fiſſures of the mountains from great depths, owing to water falling on ſubterraneous fires, and that this ſteam is condenſed between the ſtrata of the incumbent mountains, and collected into ſprings. For further proofs on this ſubject the reader is referred to a letter from Dr. Darwin in Mr. Pilkington's View of Derbyſhire, vol. I. p. 256.

Or cleave with brandiſh'd arms the lucid ſtream,
And ſob, their blue eyes twinkling in the ſteam.
—High o'er the chequer'd vault with tranſient glow
Bright luſtres dart, as daſh the waves below;
And Echo's ſweet reſponſive voice prolongs
The dulcet tumult of their ſilver tongues.—
O'er their fluſh'd cheeks uncurling treſſes flow,
And dew-drops glitter on their necks of ſnow;
Round each fair Nymph her dropping mantle clings,
And Loves emerging ſhake their ſhowery wings.

"Here oft her Lord ſurveys the rude domain,
Fair arts of Greece triumphant in his train;
Lo! as he ſteps, the column'd pile aſcends,
The blue roof cloſes, or the creſcent bends;
New woods aſpiring clothe their hills with green,
Smooth ſlope the lawns, the grey rock peeps between;
Relenting Nature gives her hand to Taſte,
And Health and Beauty crown the laughing waſte.

*And ſob, their blue eyes.* l. 184. The bath at Buxton being of 82 degrees of heat, is called a warm bath, and is ſo compared with common ſpring-water, which poſſeſſes but 48 degrees of heat, but is nevertheleſs a cold bath compared to the heat of the body, which is 98. On going into this bath there is therefore always a chill perceived at the firſt immerſion; but after having been in it a minute, the chill ceaſes, and a ſenſation of warmth ſucceeds, though the body continues to be immerſed in the water. The cauſe of this curious phenomenon is to be looked for in the laws of animal ſenſation, and not from any properties of heat. When a perſon goes from clear day-light into an obſcure room, for a while it appears gloomy, which gloom, however, in a little time ceaſes, and the deficiency of light becomes no longer perceived. This is not ſolely owing to the enlargement of the iris of the eye, ſince that is performed in an inſtant, but to this law of ſenſation, that when a leſs ſtimulus is applied (within certain bounds) the ſenſibility increaſes. Thus, at going into a bath as much colder than the body as that of Buxton, the diminution of heat on the ſkin is at firſt perceived; but in about a minute the ſenſibility to heat, increaſes and the nerves of the ſkin are equally excited by the leſſened ſtimulus. The ſenſation of warmth at emerging from a cold bath, and the pain called the hot-ach, after the hands have been immerſed in ſnow, depend on the ſame principle, viz. the increaſed ſenſibility of the ſkin after having been previouſly expoſed to a ſtimulus leſs than uſual.

*Here oft her Lord.* l. 193. Alluding to the magnificent and beautiful creſcent, and ſuperb ſtables lately erected at Buxton, for the accommodation of the company, by the Duke of Devonſhire; and to the plantations with which he has decorated the ſurrounding mountains.

VI. "*Nymphs! your* bright ſquadrons watch with chemic eyes
The cold-elaſtic vapours, as they riſe;
With playful force arreſt them as they paſs;
And to *pure* Air betroth the *flaming* Gas.
Round their tranſlucent forms at once they fling
Their rapturous arms, with ſilver boſoms cling;
In fleecy clouds their fluttering wings extend,
Or from the ſkies in lucid ſhowers deſcend;
Whence rills and rivers owe their ſecret birth,
And Ocean's hundred arms infold the earth.

"So, robed by Beauty's Queen, with ſofter charms
Saturnia woo'd the Thunderer to her arms;
O'er her fair limbs a veil of light ſhe ſpread,
And bound a ſtarry diadem on her head;
Long braids of pearl her golden treſſes grac'd,
And the charm'd Cestus ſparkled round her waiſt.
—Raiſed o'er the woof, by Beauty's hand inwrought,
Breathes the ſoft Sigh, and glows the enamour'd Thought;
Vows on light wings ſucceed, and quiver'd Wiles,
Aſſuaſive Accents, and ſeductive Smiles.

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*And to pure air.* l. 204. Until very lately water was eſteemed a ſimple element; nor are all the moſt celebrated chemiſts of Europe yet converts to the new opinion of its decompoſition. Mr. Lavoiſier, and others of the French ſchool, have moſt ingeniouſly endeavoured to ſhew, that water conſiſts of pure air, called by them oxygene, and of inflammable air, called hydrogene, with as much of the matter of heat, or calorique, as is neceſſary to preſerve them in the form of gas. Gas is diſtinguiſhed from ſteam by its preſerving its elaſticity under the preſſure of the atmoſphere, and in the greateſt degrees of cold yet known. The hiſtory of the progreſs of this great diſcovery is detailed in the Memoirs of the Royal Academy for 1781, and the experimental proofs of it are delivered in Lavoiſier's Elements of Chemiſtry. The reſults of which are, that water conſiſts of eighty-five parts, by weight, of oxygene, and fifteen parts, by weight, of hydrogene, with a ſufficient quantity of calorique. Not only numerous chemical phenomena, but many atmoſpherical and vegetable facts receive clear and beautiful elucidation from this important analyſis. In the atmoſphere, inflammable air is probably perpetually uniting with vital air, and producing moiſture, which deſcends in dews and ſhowers; while the growth of vegetables, by the aſſiſtance of light, is perpetually again decompoſing the water they imbibe from the earth, and while they retain the inflammable air for the formation of oils, wax, honey, reſin, &c. they give up the vital air to repleniſh the atmoſphere.

—Slow rolls the Cyprian car in purple pride,
And, ſteer'd by LOVE, aſcends admiring Ide;
Climbs the green ſlopes, the nodding woods pervades,
Burns round the rocks, or gleams amid the ſhades.—
Glad ZEPHYR leads the van, and waves above
The barbed darts, and blazing torch of Love;
Reverts his ſmiling face, and pauſing flings
Soft ſhowers of roſes from aurelian wings.
Delighted Fawns, in wreathes of flowers array'd,
With tiptoe Wood-Boys beat the chequer'd glade;
Alarmed Naiads, riſing into air,
Lift o'er their ſilver urns their leafy hair;
Each to her oak the baſhful Dryads ſhrink,
And azure eyes are ſeen at every chink.
—LOVE culls a flaming ſhaft of broadeſt wing,
And reſts the fork upon the quivering ſtring;
Points his arch eye aloft, with fingers ſtrong
Draws to his curled ear the ſilken thong;
Loud twangs the ſteel, the golden arrow flies,
Trails a long line of luſtre through the ſkies;
"'Tis done!" he ſhouts, "the mighty Monarch feels!"
And with loud laughter ſhakes the ſilver wheels;
Bends o'er the car, and whirling, as it moves,
His looſen'd bowſtring, drives the riſing doves.
—Pierced on his throne the ſtarting Thunderer turns,
Melts with ſoft ſighs, with kindling rapture burns;
Claſps her fair hand, and eyes in fond amaze
The bright Intruder with enamour'd gaze.
"And leaves my Goddeſs, like a blooming bride,
"The fanes of Argos for the rocks of Ide?
"Her gorgeous palaces, and amaranth bowers,
"For cliff-top'd mountains, and aerial towers?"
He ſaid; and, leading from her ivory ſeat
The bluſhing beauty to his lone retreat,

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*And ſteer'd by Love.* l. 222. The younger Love, or Cupid, the ſon of Venus, owes his exiſtence and his attributes to much later times than the Eros, or Divine Love, mentioned in Canto I. ſince the former is no where mentioned by Homer, though ſo many apt opportunities of introducing him occur in the works of that immortal bard. Bacon.

Curtain'd with night the couch imperial ſhrouds,
And reſts the crimſon cuſhions upon clouds.—
Earth feels the grateful influence from above,
Sighs the ſoft Air, and Ocean murmurs love;
Ethereal Warmth expands his brooding wing,
And in ſtill ſhowers deſcends the genial Spring,

VII. “*Nymphs of aquatic Taſte!* whoſe placid ſmile
Breathes ſweet enchantment o'er BRITANNIA's iſle;
Whoſe ſportive touch in ſhowers reſplendent flings
Her lucid cataracts, and her bubbling ſprings;
Through peopled vales the liquid ſilver guides,
And ſwells in bright expanſe her freighted tides.
*You* with nice ear, in tiptoe trains, pervade
Dim walks of morn or evening's ſilent ſhade;
Join the lone Nightingale, her woods among,
And roll your rills ſymphonious to her ſong;
Through fount-full dells, and wave-worn valleys move,
And tune their echoing waterfalls to love;
Or catch, attentive to the diſtant roar,
The pauſing murmurs of the daſhing ſhore;
Or, as aloud ſhe pours her liquid ſtrain,
Purſue the NEREID on the twilight main.
—Her playful Sea-horſe woos her ſoft commands,
Turns his quick ears, his webbed claws expands,

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*And in ſtill ſhowers.* l. 260. The allegorical interpretation of the very ancient mythology, which ſuppoſes Jupiter to repreſent the ſuperior part of the atmoſphere or ether, and Juno the inferior air, and that the conjunction of theſe two produces vernal ſhowers, as alluded to in Virgil's Georgics, is ſo analogous to the preſent important diſcovery of the production of water from pure air, or oxygene, and inflammable air, or hydrogene, (which, from its greater levity, probably reſides over the former,) that one ſhould be tempted to believe, that the very ancient chemiſts of Egypt had diſcovered the compoſition of water, and thus repreſented it in their hieroglyphic figures before the invention of letters.

In the paſſage of Virgil, Jupiter is called ether, and deſcends in prolific ſhowers on the boſom of Juno, whence the ſpring ſucceeds, and all nature rejoices.

> Tum pater omnipotens fœcundis imbribus Ether
> Conjugis in gremium lætæ deſcendit, et omnes
> Magnus alit, magno commixtus corpore, fætus.
>
> Virg. Georg. Lib. II. l. 325.

*Her playful Sea-horſe.* l. 277. Deſcribed from an antique gem.

His watery way with waving volutes wins,
Or liſtening librates on unmoving fins.
The Nymph emerging mounts her ſcaly ſeat,
Hangs o'er his gloſſy ſides her ſilver feet,
With ſnow-white hands her arching veil detains,
Gives to his ſlimy lips the ſlacken'd reins,
Lifts to the ſtar of Eve her eye ſerene,
And chaunts the birth of Beauty's radiant Queen.—
O'er her fair brow her pearly comb unfurls
Her beryl locks, and parts the waving curls,
Each tangled braid with gliſtening teeth unbinds,
And with the floating treaſure muſks the winds.—
Thrill'd by the dulcet accents, as ſhe ſings,
The rippling wave in widening circles rings;
Night's ſhadowy forms along the margin gleam
With pointed ears, or dance upon the ſtream;
The Moon tranſported ſtays her bright career,
And maddening Stars ſhoot headlong from the ſphere.

VIII. "*Nymphs!* whoſe fair eyes with vivid luſtres glow
For human weal, and melt at human woe;
Late as *you* floated on your ſilver ſhells,
Sorrowing and ſlow by DERWENT's willowy dells;
Where by tall groves his foamy flood he ſteers
Through ponderous arches o'er impetuous wears,
By DERBY's ſhadowy towers reflective ſweeps,
And gothic grandeur chills his duſky deeps;
*You* pearl'd with Pity's drops his velvet ſides,
Sigh'd in his gales, and murmur'd in his tides,
Waved o'er his fringed brink a deeper gloom,
And bow'd his alders o'er MILCENA's tomb.

"Oft with ſweet voice She led her infant-train,
Printing with graceful ſtep his ſpangled plain,
Explored his twinkling ſwarms, that ſwim or fly,
And mark'd his florets with botanic eye.—

*O'er Milcena's tomb.* l. 308. In memory of Mrs. French, a lady who, to many other elegant accompliſhments, added a proficiency in botany and natural hiſtory.

" Sweet bud of Spring! how frail thy tranſient bloom,
" Fine film," ſhe cried, " of Nature's faireſt loom!
" Soon Beauty fades upon its damaſk throne!"—
—Unconſcious of the worm, that mined her own!—
—Pale are thoſe lips, where ſoft careſſes hung,
Wan the warm cheek, and mute the tender tongue,
Cold reſts that feeling heart on DERWENT's ſhore,
And thoſe love-lighted eye-balls roll no more!

" *Here* her ſad Conſort, ſtealing through the gloom
Of murmuring cloyſters, gazes on her tomb;
Hangs in mute anguiſh o'er the ſcutcheon'd hearſe,
Or graves with trembling ſtyle the votive verſe.

" Sexton! oh, lay beneath this ſacred ſhrine,
" When Time's cold hand ſhall cloſe my aching eyes;
" Oh, gently lay this wearied earth of mine,
" Where wrap'd in night my loved MILCENA lies.

" So ſhall with purer joy my ſpirit move
" When the laſt trumpet thrills the caves of Death,
" Catch the firſt whiſpers of my waking love,
" And drink with holy kiſs her kindling breath.

" The ſpotleſs Fair, with bluſh ethereal warm,
" Shall hail with ſweeter ſmile returning day,
" Riſe from her marble bed a brighter form,
" And win on buoyant ſtep her airy way.

" Shall bend approved, where beckoning hoſts invite,
" On clouds of ſilver, her adoring knee,
" Approach with Seraphim the throne of light,
" —And *Beauty* plead with angel-tongue for Me!"

IX. " *Your* virgin trains on BRINDLEY's cradle ſmiled,
And nurſed with fairy-love the unletter'd child,

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*On Brindley's cradle ſmiled.* l. 341. The life of Mr. Brindley, whoſe great abilities in the conſtruction of canal navigation were called forth by the patronage of the Duke of Bridgewater, may be read in Dr. Kippis's Biogra-

Spread round his pillow all your ſecret ſpells,
Pierced all your ſprings, and open'd all your wells.—
As now on graſs, with gloſſy folds reveal'd, 345
Glides the bright ſerpent, now in flowers conceal'd;
Far ſhine the ſcales, that gild his ſinuous back,
And lucid undulations mark his track;
So with ſtrong arm immortal **Brindley** leads
His long canals, and parts the velvet meads; 350
Winding in lucid lines, the watery maſs
Mines the firm rock, or loads the deep moraſs,
With riſing locks a thouſand hills alarms,
Flings o'er a thouſand ſtreams its ſilver arms,
Feeds the long vale, the nodding woodland laves, 355
And Plenty, Arts, and Commerce freight the waves.
—*Nymphs!* who erewhile round **Brindley**'s early bier
On ſnow-white boſoms ſhower'd the inceſſant tear,
Adorn his tomb!—oh, raiſe the marble buſt,
Proclaim his honours, and protect his duſt! 360
With urns inverted, round the ſacred ſhrine
Their ozier wreaths let weeping Naiads twine;
While on the top **Mechanic Genius** ſtands,
Counts the fleet waves, and balances the lands.

X. "*Nymphs! you* firſt taught to pierce the ſecret caves
Of humid earth, and lift her ponderous waves; 366

phia Britannica; the excellence of his genius is viſible in every part of this iſland. He died at Turnhurſt, in Staffordſhire, in 1772, and ought to have a monument in the cathedral church at Lichfield.

*Lift her ponderous waves.* l. 366. The invention of the pump is of very ancient date, being aſcribed to one Cteſebes, an Athenian, whence it was called by the Latins machina Cteſebiana; but it was long before it was known that the aſcent of the piſton lifted the ſuperincumbent column of the atmoſphere, and that then the preſſure of the ſurrounding air, on the ſurface of the well below, forced the water up into the vacuum, and that, on that account, in the common lifting pump, the water would riſe only about thirty-five feet, as the weight of ſuch a column of water was, in general, an equipoiſe to the ſurrounding atmoſphere. The foamy appearance of water, when the preſſure of the air over it is diminiſhed, is owing to the expanſion and eſcape of the air previouſly diſſolved by it, or exiſting in its pores.—When a child firſt ſucks, it only preſſes or champs the teat, as obſerved by the great Harvey, but afterwards it learns to make an incipient vacuum in its mouth, and acts, by removing the preſſure of the atmoſphere from the nipple, like a pump.

with quick ſtroke the ſliding piſton bear
iewleſs columns of incumbent air;—
l by the incumbent air the floods below,
igh opening valves in foaming torrents flow,
after foot with leſſen'd impulſe move,
iſing ſeek the vacancy above.—
ien the Mother, bending o'er his charms,
s her fair nurſeling in delighted arms;
ws the thin kerchief from her neck of ſnow,
ialf unveils the pearly orbs below;
ſparkling eye the blameleſs Plunderer owns
oft embraces, and endearing tones,
the ſalubrious fount with opening lips,
ds his inquiring hands, and ſmiles, and ſips.

*onnubial Fair!* whom no fond tranſport warms
ll your infant in maternal arms;
, bleſs'd in vain with tumid boſoms, hear
nder wailings with unfeeling ear;
oothing kiſs and milky rill deny,
e ſweet pouting lip, and gliſtening eye!—
what avails the cradle's damaſk roof,
ider bolſter, and embroider'd woof!—
ears the gilded couch unpity'd plains,
many a tear the taſſel'd cuſhion ſtains!
oice ſo ſweet attunes his cares to reſt,
t no pillow as his Mother's breaſt!—
us charm'd to ſweet repoſe, when twilight hours
heir ſoft influence on celeſtial bowers,
herub, Innocence, with ſmile divine
his white wings, and ſleeps on Beauty's ſhrine.

“From dome to dome when flames infuriate climb,
the long ſtreet, inveſt the tower ſublime;
ie tall vanes amid the aſtoniſh'd night,
eddening heaven returns the ſanguine light;

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*what avails*. l. 387. From an elegant little poem of Mr. Jerning-
ntitled Il Latte, exhorting ladies to nurſe their own children.

While with vaſt ſtrides and briſtling hair aloof
Pale Danger glides along the falling roof;
And Giant Terror, howling in amaze,
Moves his dark limbs acroſs the lurid blaze.
*Nymphs! you* firſt taught the gelid wave to riſe,
Hurl'd in reſplendent arches to the ſkies;
In iron cells condenſed the airy ſpring,
And imp'd the torrent with unfailing wing;
—On the fierce flames the ſhower impetuous falls,
And ſudden darkneſs ſhrouds the ſhatter'd walls;
Steam, ſmoke, and duſt, in blended volumes roll,
And Night and Silence repoſſeſs the Pole.—

" Where were ye, *Nymphs!* in thoſe diſaſterous hours,
Which wrap'd in flames AUGUSTA's ſinking towers?
Why did ye linger in your wells and groves,
When ſad WOODMASON mourn'd her infant loves?
When thy fair Daughters with unheeded ſcreams,
Ill-fated MOLESWORTH! call'd the loitering ſtreams!—
The trembling Nymph, on bloodleſs fingers hung,
Eyes from the tottering wall the diſtant throng,
With ceaſeleſs ſhrieks her ſleeping friends alarms,
Drops with ſinged hair into her lover's arms.—

*Hurl'd in reſplendent arches.* l. 406. The addition of an air-cell to machines for raiſing water to extinguiſh fire, was firſt introduced by Mr. Newſham, of London, and is now applied to ſimilar engines for waſhing wall-trees in gardens, and to all kinds of forcing pumps, and might be applied, with advantage, to lifting pumps, where the water is brought from a great diſtance horizontally. Another kind of machine was invented by one Greyl, in which a veſſel of water was every way diſperſed by the exploſion of gun-powder lodging in the centre of it, and lighted by an adapted match; from this idea Mr. Godfrey propoſed a water-bomb of ſimilar conſtruction. Dr. Hales, to prevent the ſpreading of fire, propoſed to cover the floors and ſtairs of the adjoining houſes with earth: Mr. Hartley propoſed to prevent houſes from taking fire, by covering the cieling with thin iron plates; and Lord Mahon, by a bed of coarſe mortar, or plaiſter, between the cieling and floor above it. May not this age of chemical ſcience diſcover ſome method of injecting or ſoaking timber with lime-water, and afterwards with vitriolic acid, and thus fill its pores with alabaſter? or of penetrating it with ſiliceous matter, by proceſſes ſimilar to thoſe of Bergman and Achard? See Cronſtedt's Mineral. 2d edit. vol. I. p. 222.

*Woodmaſon. Moleſworth.* l. 416, 418. The hiſtories of theſe unfortunate families may be ſeen in the Annual Regiſter, or in the Gentleman's Magazine.

The illumin'd Mother ſeeks with footſteps fleet,
Where hangs the ſafe balcony o'er the ſtreet;
Wrap'd in her ſheet her youngeſt hope ſuſpends, 425
And panting lowers it to her tiptoe friends;
Again ſhe hurries on Affection's wings,
And now a third, and now a fourth, ſhe brings;
Safe all her babes, ſhe ſmooths her horrent brow,
And burſts through bickering flames, unſcorch'd, below.
So, by her Son arraigned, with feet unſhod 431
O'er burning bars indignant Emma trod.

" E'en on the day when Youth with Beauty wed,
The flames ſurpriſed them in their nuptial bed;—
Seen at the opening ſaſh with boſom bare, 435
With wringing hands, and dark diſhevel'd hair,
The bluſhing Bride, with wild diſorder'd charms,
Round her fond lover winds her ivory arms;
Beat, as they claſp, their throbbing hearts with fear,
And many a kiſs is mix'd with many a tear;— 440
Ah me! in vain the labouring engines pour
Round their pale limbs the ineffectual ſhower!—
—Then craſh'd the floor, while ſhrinking crouds retire,
And Love and Virtue ſunk amid the fire!—
With piercing ſcreams afflicted ſtrangers mourn, 445
And their white aſhes mingle in their urn.

XII. " *Pellucid Forms!* whoſe cryſtal boſoms ſhow
The ſhine of welfare, or the ſhade of woe;
Who with ſoft lips ſalute returning Spring,
And hail the Zephyr quivering on his wing; 450
Or watch, untired, the wintery clouds, and ſhare
With ſtreaming eyes my vegetable care;
Go, ſhove the dim miſt from the mountain's brow,
Chaſe the white fog, which floods the vale below;
Melt the thick ſnows, that linger on the lands, 455
And catch the hail-ſtones in your little hands;

---

*Shove the dim miſt.* l. 453. See note on l. 20 of this Canto.
*Catch the hail-ſtones.* l. 456. See note on l. 15 of this Canto.

Guard the coy bloſſom from the pelting ſhower,
And daſh the rimy ſpangles from the bower;
From each chill leaf the ſilvery drops repel,
And cloſe the timorous floret's golden bell. 460

"So ſhould young *Sympathy*, in female form,
Climb the tall rock, ſpectatreſs of the ſtorm;
Life's ſinking wrecks with ſecret ſighs deplore,
And bleed for others' woes, Herſelf on ſhore;

*From each chill leaf.* l. 459. The upper ſide of the leaf is the organ of vegetable reſpiration, as explained in the additional notes, No. XXXVII. hence the leaf is liable to injury from much moiſture on this ſurface, and is deſtroyed by being ſmeared with oil, in theſe reſpects reſembling the lungs of animals, or the ſpiracula of inſects. To prevent theſe injuries, ſome leaves repel the dew-drops from their upper ſurfaces, as thoſe of cabbages; other vegetables cloſe the upper ſurfaces of their leaves together in the night, or in wet weather, as the ſenſitive plant; others only hang their leaves downwards, ſo as to ſhoot the wet from them, as kidney-beans, and many trees. See note on l. 18 of this Canto.

*Golden bell.* l. 460. There are muſcles placed about the foot-ſtalks of the leaves or leaflets of many plants, for the purpoſe of cloſing their upper ſurfaces together, or of bending them down ſo as to ſhoot off the ſhowers or dew-drops, as mentioned in the preceding note. The claws of the petals, or of the diviſions of the calyx of many flowers, are furniſhed in a ſimilar manner with muſcles, which are exerted to open or cloſe the corol and calyx of the flower, as in tragopogon, anemone. This action of opening and cloſing the leaves or flowers, does not appear to be produced ſimply by *irritation* on the muſcles themſelves, but by the connection of thoſe muſcles with a *ſenſitive* ſenſorium, or brain, exiſting in each individual bud or flower. 1ſt. Becauſe many flowers cloſe from the defect of ſtimulus, not by the exceſs of it, as by darkneſs, which is the abſence of the ſtimulus of light; or by cold, which is the abſence of the ſtimulus of heat. Now, the defect of heat, or the abſence of food, or of drink, affects our *ſenſations*, which had been previouſly accuſtomed to a greater quantity of them; but a muſcle cannot be ſaid to be ſtimulated into action by a defect of ſtimulus. 2d. Becauſe the muſcles around the foot-ſtalks of the ſubdiviſions of the leaves of the ſenſitive plant are exerted when any injury is offered to the other extremity of the leaf, and ſome of the ſtamens of the flowers of the claſs Syngeneſia, contract themſelves when others are irritated. See note on Chondrilla, vol. II. of this work.

From this circumſtance, the contraction of the muſcles of vegetables ſeems to depend on a diſagreeable *ſenſation* in ſome diſtant part, and not on the *irritation* of the muſcles themſelves. Thus, when a particle of duſt ſtimulates the ball of the eye, the eye-lids are inſtantly cloſed, and when too much light pains the retina, the muſcles of the iris contract its aperture, and this not by any connection or conſent of the nerves of thoſe parts, but as an effort to prevent or to remove a diſagreeable ſenſation, which evinces that vegetables are endued with ſenſation, or that each bud has a common ſenſorium, and is furniſhed with a brain, or a central place, where its nerves are connected.

To friendleſs Virtue, gaſping on the ſtrand,
Bare her warm heart, her virgin arms expand,
Charm with kind looks, with tender accents cheer,
And pour the ſweet conſolatory tear;
Grief's cureleſs wounds with lenient balms aſſwage,
Or prop with firmer ſtaff the ſteps of Age;
The lifted arm of mute Deſpair arreſt,
And ſnatch the dagger pointed at his breaſt;
Or lull to ſlumber Envy's haggard mien,
And rob her quiver'd ſhafts with hand unſeen.
—Sound, *Nymphs of* HELICON! the trump of Fame,
And teach Hibernian echoes JONES's name;
Bind round her poliſh'd brow the civic bay,
And drag the fair Philanthropiſt to day.—
So from ſecluded ſprings, and ſecret caves,
Her Liffy pours his bright meandering waves,
Cools the parch'd vale, the ſultry mead divides,
And towns and temples ſtar his ſhadowy ſides.

XIII. "*Call your* light legions, tread the ſwampy heath,
Pierce with ſharp ſpades the tremulous peat beneath;
With colters bright the ruſhy ſward biſect,
And in new veins the guſhing rills direct;—
So flowers ſhall riſe in purple light array'd,
And bloſſom'd orchards ſtretch their ſilver ſhade;
Admiring glebes their amber ears unfold,
And Labour ſleep amid the waving gold.

"Thus when young HERCULES, with firm diſdain,
Braved the ſoft ſmiles of Pleaſure's harlot train;
To valiant toils his forceful limbs aſſign'd,
And gave to Virtue all his mighty mind;
Fierce ACHELOUS ruſh'd from mountain-caves,
O'er ſad Etolia pour'd his waſteful waves,

---

*Jones's name.* l. 476. A young lady who devotes a great part of an ample fortune to well-choſen acts of ſecret charity.

*Fierce Achelous.* l. 495. The river Achelous deluged Etolia, by one of its branches or arms, which, in the ancient languages, are called horns, and produced famine throughout a great tract of country: this was repreſented in

O'er lowing vales and bleating paſtures roll'd,
Swept her red vineyards, and her glebes of gold,
Mined all her towns, uptore her rooted woods,
And Famine danced upon the ſhining floods.
The youthful Hero ſeized his curled creſt,
And daſh'd with lifted club the watery Peſt;
With waving arm the billowy tumult quell'd,
And to his courſe the bellowing Fiend repell'd.

"Then to a Snake the finny Demon turn'd,
His lengthen'd form with ſcales of ſilver burn'd;
Laſh'd with reſiſtleſs ſweep his dragon-train,
And ſhot meandering o'er the affrighted plain.
The Hero-God, with giant fingers claſp'd
Firm round his neck, the hiſſing monſter graſp'd;
With ſtarting eyes, wide throat, and gaping teeth,
Curl his redundant folds, and writhe in death.

"And now a Bull, amid the flying throng
The griſly Demon foam'd, and roar'd along;
With ſilver hoofs the flowery meadows ſpurn'd,
Roll'd his red eye, his threatening antlers turn'd;
Dragg'd down to earth the Warrior's victor-hands,
Preſs'd his deep dewlap on the imprinted ſands;
Then with quick bound his bended knee he fix'd
High on his neck, the branching horns betwixt,
Strain'd his ſtrong arms, his ſinewy ſhoulders bent,
And from his curled brow the twiſted terror rent.
—Pleaſed Fawns and Nymphs with dancing ſtep applaud,
And hang their chaplets round the reſting God;
Link their ſoft hands, and rear, with pauſing toil,
The golden trophy on the furrow'd ſoil;

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hieroglyphic emblems, by the winding courſe of a ſerpent, and the roaring of a bull with large horns. Hercules, or the emblem of ſtrength, ſtrangled the ſerpent, and tore off one horn from the bull; that is, he ſtopped, and turned the courſe of one arm of the river, and reſtored plenty to the country. Whence the ancient emblem of the horn of plenty. Dict. par M. Danet.

*Dragg'd down to earth.* l. 517. Deſcribed from an antique gem.

Fill with ripe fruits, with wreathed flowers adorn,
And give to *Plenty* her prolific horn.

XIV. "On Spring's fair lip, *cerulean Siſters!* pour
From airy urns the ſun-illumin'd ſhower,
Feed with the dulcet drops my tender broods,
Mellifluous flowers, and aromatic buds;
Hang from each bending graſs and horrent thorn
The tremulous pearl, that glitters to the morn;
Or where cold dews their ſecret channels lave,
And Earth's dark chambers hide the ſtagnant wave,
Oh pierce, *ye Nymphs!* her marble veins, and lead
Her guſhing fountains to the thirſty mead;
Wide o'er the ſhining vales, and trickling hills
Spread the bright treaſure in a thouſand rills.
So ſhall my peopled realms of Leaf and Flower
Exult, inebriate with the genial ſhower;
Dip their long treſſes from the moſſy brink,
With tufted roots the glaſſy currents drink;

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*Spread the bright treaſure.* l. 540. The practice of flooding lands, long in uſe in China, has been but lately introduced into this country. Beſides the ſupplying water to the herbage in dryer ſeaſons, it ſeems to defend it from froſt in the early part of the year, and thus doubly advances the vegetation. The waters which riſe from ſprings paſſing through marl or limeſtone, are replete with calcareous earth, and when thrown over moraſſes, they depoſit this earth, and incruſt or conſolidate the moraſs. This kind of earth is depoſited in great quantity from the ſprings at Matlock bath, and ſupplies the ſoft porous limeſtone, of which the houſes and walls are there conſtructed; and has formed the whole bank, for near a mile, on that ſide of the Derwent on which they ſtand.

The water of many ſprings contains much azotic gas, or phlogiſtic air, beſides carbonic gas, or fixed air, as that of Buxton and Bath; this being ſet at liberty, may more readily contribute to the production of nitre, by means of the putreſcent matters which it is expoſed to by being ſpread upon the ſurface of the land, in the ſame manner as frequently turning over heaps of manure facilitates the nitrous proceſs, by impriſoning atmoſpheric air in the interſtices of the putreſcent materials. Water, ariſing by land-floods, brings along with it much of the moſt ſoluble parts of the manure from the higher lands to the lower ones. River-water, in its clear ſtate, and thoſe ſprings which are called ſoft, are leſs beneficial for the purpoſe of watering lands, as they contain leſs earthy or ſaline matter; and water, from diſſolving ſnow from its ſlow ſolution, brings but little earth along with it, as may be ſeen by the comparative clearneſs of the water of ſnow-floods.

Shade your cool manſions from meridian beams,
And view their waving honours in your ſtreams.

"Thus where the veins their confluent branches bend,
And milky eddies with the purple blend;
The Chyle's white trunk, diverging from its ſource,
Seeks through the vital maſs its ſhining courſe;
O'er each red cell, and tiſſued membrane ſpreads,
In living net-work, all its branching threads;
Maze within maze its tortuous path purſues,
Winds into glands, inextricable clues;
Steals through the ſtomach's velvet ſides, and ſips
The ſilver ſurges with a thouſand lips;
Fills each fine pore, pervades each ſlender hair,
And drinks ſalubrious dew-drops from the air.

"Thus when to kneel in Mecca's awful gloom,
Or preſs with pious kiſs MEDINA's tomb,
League after league, through many a lingering day,
Steer the ſwart Caravans their ſultry way;
O'er ſandy waſtes on gaſping camels toil,
Or print with pilgrim-ſteps the burning ſoil;
If from lone rocks a ſparkling rill deſcend,
O'er the green brink the kneeling nations bend,
Bathe the parch'd lip, and cool the feveriſh tongue,
And the clear lake reflects the mingled throng."

*The Goddeſs pauſed*,—the liſtening bands awhile
Still ſeem to hear, and dwell upon her ſmile;
Then with ſoft murmur ſweep in lucid trains
Down the green ſlopes, and o'er the pebbly plains,
To each bright ſtream on ſilver ſandals glide,
Reflective fountain, and tumultuous tide.

So ſhoot the Spider-broods at breezy dawn,
Their glittering net-work o'er the autumnal lawn;
From blade to blade connect with cordage fine
The unbending graſs, and live along the line;

Or bathe unwet their oily forms, and dwell
With feet repulſive on the dimpling well.

So when the North congeals his watery maſs,
Piles high his ſnows, and floors his ſeas with glaſs;
While many a Month, unknown to warmer rays,
Marks its ſlow chronicle by lunar days;
Stout youths and ruddy damſels, ſportive train,
Leave the white ſoil, and ruſh upon the main;
From iſle to iſle the moon-bright ſquadrons ſtray,
And win in eaſy curves their graceful way;
On ſtep alternate borne, with balance nice,
Hang o'er the gliding ſteel, and hiſs along the ice.

# ARGUMENT

OF THE

# *FOURTH CANTO.*

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# THE
# BOTANIC GARDEN.

## ECONOMY OF VEGETATION.

### CANTO IV.

AS when at noon in Hybla's fragrant bowers
CACALIA opens all her honey'd flowers;
Contending ſwarms on bending branches cling,
And nations hover on aurelian wing;
So round the *Goddeſs*, ere ſhe ſpeaks, on high
Impatient *Sylphs* in gaudy circlets fly;
Quivering in air their painted plumes expand,
And coloured ſhadows dance upon the land.

I. " *Sylphs! your* light troops the tropic Winds confine,
And guide their ſtreaming arrows to the Line;
While in warm floods ecliptic Breezes riſe,
And ſink with wings benumb'd in colder ſkies.

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*Cacalia opens*. l. 2. The importance of the nectarium, or honey-gland, in the vegetable economy, is ſeen from the very complicated apparatus which nature has formed in ſome flowers, for the preſervation of their honey from inſects, as in the aconites or monkſhoods; in other plants, inſtead of a great apparatus for its protection, a greater ſecretion of it is produced, that thence a part may be ſpared to the depredation of inſects. The cacalia ſuaveolens produces ſo much honey, that, on ſome days, it may be ſmelt at a great diſtance from the plant. I remember once counting on one of theſe plants, beſides bees of various kinds without number, above two hundred painted butterflies, which gave it the beautiful appearance of being covered with additional flowers.

*The tropic winds*. l. 9. See additional notes, No. XXXIII.

*You* bid Monſoons on Indian ſeas reſide,
And veer, as moves the ſun, their airy tide;
While ſouthern Gales o'er weſtern oceans roll,
And Eurus ſteals his ice-winds from the Pole.
*Your* playful trains, on ſultry iſlands born,
Turn on fantaſtic toe at eve and morn;
With ſoft ſuſurrant voice alternate ſweep
Earth's green pavilions and encircling deep.
*Or* in itinerant cohorts, borne ſublime
On tides of ether, float from clime to clime;
O'er waving Autumn bend your airy ring,
Or waft the fragrant boſom of the Spring.

II. "When Morn, eſcorted by the dancing Hours,
O'er the bright plains her dewy luſtre ſhowers;
Till from her ſable chariot Eve ſerene
Drops the dark curtain o'er the brilliant ſcene;
*You* form with chemic hands the airy ſurge,
Mix with broad vans, with ſhadowy tridents urge.
*Sylphs!* from each ſun-bright leaf, that twinkling ſhakes
O'er Earth's green lap, or ſhoots amid her lakes,
Your playful bands with ſimpering lips invite,
And wed the enamour'd OXYGENE to LIGHT.—

*The enamour'd Oxygene.* l. 34. The common air of the atmoſphere appears, by the analyſis of Dr. Prieſtley, and other philoſophers, to conſiſt of about three parts of an elaſtic fluid, unfit for reſpiration or combuſtion, called azote by the French ſchool, and about one fourth of pure vital air, fit for the ſupport of animal life and of combuſtion, called oxygene. The principal ſource of the azote is probably from the decompoſition of all vegetable and animal matters by putrefaction and combuſtion: the principal ſource of vital air, or oxygene, is, perhaps, from the decompoſition of water in the organs of vegetables, by means of the ſun's light. The difficulty of injecting vegetable veſſels ſeems to ſhew, that their perſpirative pores are much leſs than thoſe of animals, and that the water which conſtitutes their perſpiration is ſo divided at the time of its excluſion, that, by means of the ſun's light, it becomes decompoſed; the inflammable air, or hydrogene, which is one of its conſtituent parts, being retained to form the oil, reſin, wax, honey, &c. of the vegetable economy; and the other part, which, united with light or heat, becomes vital air, or oxygene gas, riſes into the atmoſphere, and repleniſhes it with the food of life.

Dr. Prieſtley has evinced, by very ingenious experiments, that the blood gives out phlogiſton, and receives vital air, or oxygene gas, by the lungs. And Dr. Crawford has ſhewn, that the blood acquires heat from this vital air in reſpiration. There is, however, ſtill a ſomething more ſubtil than

Round their white necks with fingers interwove,
Cling the fond Pair with unabating love;
Hand link'd in hand on buoyant ſtep they riſe,
And ſoar and gliſten in unclouded ſkies.
Whence in bright floods the *Vital Air* expands,
And with concentric ſpheres involves the lands;
Pervades the ſwarming ſeas, and heaving earths,
Where teeming Nature broods her myriad births;
Fills the fine lungs of all that *breathe* or *bud*,
Warms the new heart, and dyes the guſhing blood;
With Life's firſt ſpark inſpires the organic frame,
And, as it waſtes, renews the ſubtile flame.

"So pure, ſo ſoft, with ſweet attraction ſhone
Fair PSYCHE, kneeling at the ethereal throne;
Won with coy ſmiles the admiring court of Jove,
And warm'd the boſom of unconquer'd *Love*.—
Beneath a moving ſhade of fruits and flowers
Onward they march to *Hymen's* ſacred bowers;
With lifted torch he lights the feſtive train,
Sublime, and leads them in his golden chain;
Joins the fond pair, indulgent to their vows,
And hides with myſtic veil their bluſhing brows.
Round their fair forms their mingling arms they fling,
Meet with warm lip, and claſp with ruſtling wing.—
—Hence plaſtic Nature, as Oblivion whelms
Her fading forms, re-peoples all her realms;

---

heat, which muſt be obtained in reſpiration from the vital air; a ſomething which life cannot exiſt a few minutes without, which ſeems neceſſary to the vegetable as well as to the animal world, and which, as no organized veſſels can confine it, requires perpetually to be renewed. See note on Canto I. l. 401, and additional notes, No. XXXIV.

*Fair Pſyche.* l. 48. Deſcribed from an ancient gem, on a fine onyx, in poſſeſſion of the Duke of Marlborough, of which there is a beautiful print in Bryant's Mythol. vol. II. p. 392. And from another ancient gem of Cupid and Pſyche embracing, of which there is a print in Spence's Polymetis, p. 82.

*Re-peoples all her realms.* l. 60.

Quæ mare navigerum et terras frugiferentes
Concelebras; per te quoniam genus omne animantum
Concipitur, viſitque exortum lumina ſolis. Lucret.

Soft Joys diſport on purple plumes unfurl'd,
And Love and Beauty rule the willing world.

III. 1. "*Sylphs! your* bold myriads on the withering heath
Stay the fell SYROC's ſuffocative breath;
Arreſt SIMOOM in his realms of ſand, 65
The poiſoned javelin balanced in his hand;—
Fierce on blue ſtreams he rides the tainted air,
Points his keen eye, and waves his whiſtling hair;

*Arreſt Simoom.* l. 65. "At eleven o'clock, while we were, with great pleaſure, contemplating the rugged tops of Chiggre, where we expected to ſolace ourſelves with plenty of good water, Idris cried out, with a loud voice, 'fall upon your faces, for here is the ſimoom!' I ſaw from the S. E. a haze come in colour like the purple part of a rainbow, but not ſo compreſſed or thick; it did not occupy twenty yards in breadth, and was about twelve feet high from the ground. It was a kind of a bluſh upon the air, and it moved very rapidly, for I ſcarce could turn to fall upon the ground, with my head to the northward, when I felt the heat of its current plainly upon my face. We all lay flat upon the ground, as if dead, till Idris told us it was blown over. The meteor, or purple haze which I ſaw, was indeed paſſed, but the light air that ſtill blew, was of heat to threaten ſuffocation. For my part, I found diſtinctly in my breaſt, that I had imbibed a part of it; nor was I free of an aſthmatic ſenſation till I had been ſome months in Italy." Bruce's Travels, vol. IV. p. 557.

It is difficult to account for the narrow track of this peſtilential wind, which is ſaid not to exceed twenty yards, and for its ſmall elevation of twelve feet. A whirlwind will paſs forwards, and throw down an avenue of trees, by its quick revolution, as it paſſes; but nothing like a whirlwind is deſcribed as happening in theſe narrow ſtreams of air, and whirlwinds aſcend to greater heights. There ſeems but one known manner in which this channel of air could be effected, and that is by electricity.

The volcanic origin of theſe winds is mentioned in the note on Chunda, in vol. II. of this work: it muſt here be added, that Profeſſor Vairo, at Naples, found, that during the eruption of Veſuvius, perpendicular iron bars were electric; and others have obſerved ſuffocating damps to attend theſe eruptions. Ferber's Travels in Italy, p. 133. And, laſtly, that a current of air attends the paſſage of electric matter, as is ſeen in preſenting an electrized point to the flame of a candle. In Mr. Bruce's account of this ſimoom, it was in its courſe over a quite dry deſert of ſand, (and which was, in conſequence, unable to conduct an electric ſtream into the earth beneath it,) to ſome moiſt rocks at but a few miles diſtance, and thence would appear to be a ſtream of electricity from a volcano, attended with noxious air; and as the bodies of Mr. Bruce and his attendants were inſulated on the ſand, they would not be ſenſible of their increaſed electricity, as it paſſed over them; to which it may be added, that a ſulphurous or ſuffocating ſenſation is ſaid to accompany flaſhes of lightning, and even ſtrong ſparks of artificial electricity. In the above account of the ſimoom, a great redneſs in the air is ſaid to be a certain ſign of its approach, which may be occaſioned by the eruption of flame from a diſtant volcano in theſe extenſive and impenetrable deſerts of ſand. See note on l. 292 of this Canto.

While, as he turns, the undulating ſoil
Rolls in red waves, and billowy deſerts boil.

You ſeize TORNADO by his locks of miſt,
Burſt his denſe clouds, his wheeling ſpires untwiſt;
Wide o'er the Weſt, when borne on headlong gales,
Dark as meridian night, the Monſter ſails,
Howls high in air, and ſhakes his curled brow,
Laſhing with ſerpent-train the waves below,
Whirls his black arm, the forked lightning flings,
And ſhowers a deluge from his demon-wings.

2. " *Sylphs!* with light ſhafts *you* pierce the drowſy FOG,
That lingering ſlumbers on the ſedge-wove bog,
With webbed feet o'er midnight meadows creeps,
Or flings his hairy limbs on ſtagnant deeps.
*You* meet *Contagion* iſſuing from afar,
And daſh the baleful conqueror from his car;
When, Gueſt of *Death!* from charnel vaults he ſteals,
And bathes in human gore his armed wheels.

" Thus when the *Plague*, upborne on Belgian air,
Look'd through the miſt, and ſhook his clotted hair;
O'er ſhrinking nations ſteer'd malignant clouds,
And rain'd deſtruction on the gaſping crouds.
The beauteous ÆGLE felt the venom'd dart,
Slow roll'd her eye, and feebly throbb'd her heart;
Each fervid ſigh ſeem'd ſhorter than the laſt,
And ſtarting Friendſhip ſhunn'd her, as ſhe paſs'd.

*Tornado.* l. 71. See additional notes, No. XXXIII.

*On ſtagnant deeps.* l. 82. All contagious miaſmata originate either from animal bodies, as thoſe of the ſmall-pox, or from putrid moraſſes; theſe latter produce agues in the colder climates, and malignant fevers in the warmer ones. The volcanic vapours which cauſe epidemic coughs, are to be ranked amongſt poiſons, rather than amongſt the miaſmata, which produce contagious diſeaſes.

*The beauteous Ægle.* l. 91. When the plague raged in Holland, in 1636, a young girl was ſeized with it, had three carbuncles, and was removed to a garden, where her lover, who was betrothed to her, attended her as a nurſe, and ſlept with her as his wife. He remained uninfected, and ſhe recovered, and was married to him. The ſtory is related by Vinc. Fabricius, in the Miſc. Cur. Ann. II. Obſ. 188.

—With weak unſteady ſtep the fainting Maid
Seeks the cold garden's ſolitary ſhade,
Sinks on the pillowy moſs her drooping head,
And prints with lifeleſs limbs her leafy bed.
—On wings of Love her plighted Swain purſues,
Shades her from winds, and ſhelters her from dews,
Extends on tapering poles the canvas roof,
Spreads o'er the ſtraw-wove matt, the flaxen woof,
Sweet buds and bloſſoms on her bolſter ſtrows,
And binds his kerchief round her aching brows;
Sooths with ſoft kiſs, with tender accents charms,
And claſps the bright infection in his arms.—
With pale and languid ſmiles the grateful Fair
Applauds his virtues, and rewards his care;
Mourns with wet cheek her fair companions fled
On timorous ſtep, or number'd with the dead;
Calls to her boſom all its ſcatter'd rays,
And pours on THYRSIS the collected blaze;
Braves the chill night, careſſing and careſs'd,
And folds her Hero-lover to her breaſt.—
Leſs bold, LEANDER at the duſky hour
Eyed, as he ſwam, the far love-lighted tower;
Breaſted with ſtruggling arms the toſſing wave,
And ſunk benighted in the watery grave.
Leſs bold, TOBIAS claim'd the nuptial bed
Where ſeven fond Lovers by a Fiend had bled;
And drove, inſtructed by his Angel-Guide,
The enamour'd Demon from the fatal bride.—
—*Sylphs!* while your winnowing pinions fann'd the air,
And ſhed gay viſions o'er the ſleeping pair;
*Love* round their couch effuſed his roſy breath,
And with his keener arrows conquer'd *Death*.

IV. 1. "You charm'd, indulgent *Sylphs!* their learned toil,
And crown'd with fame your TORRICELL and BOYLE;

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*Torricell and Boyle.* l. 128. The preſſure of the atmoſphere was diſcovered by Torricelli, a diſciple of Galileo, who had previouſly found that the air had weight. Dr. Hook, and M. du Hamel, aſcribe the invention of the air-pump to Mr. Boyle, who, however, confeſſes he had ſome hints concerning

Taught with ſweet ſmiles, reſponſive to their prayer,
The ſpring and preſſure of the viewleſs air.
—How up exhauſted tubes bright currents flow
Of liquid ſilver from the lake below,
Weigh the long column of the incumbent ſkies,
And with the changeful moment fall and riſe.
—How, as in brazen pumps the piſtons move,
The membrane-valve ſuſtains the weight above;
Stroke follows ſtroke, the gelid vapour falls,
And miſty dew-drops dim the cryſtal walls;
Rare and more rare expands the fluid thin,
And Silence dwells with Vacancy within.—
So in the mighty Void with grim delight
Primeval Silence reign'd with ancient Night.

2. "*Sylphs!* your ſoft voices, whiſpering from the ſkies,
Bade from low earth the bold MONGOLFIER riſe;

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its conſtruction from de Guerick. The vacancy at the ſummit of the barometer is termed the Torricellian vacuum, and the exhauſted receiver of an air-pump, the Boylean vacuum, in honour of theſe two philoſophers.

The miſt and deſcending dew which appear at firſt exhauſting the receiver of an air-pump, are explained in the Phil. Tranſ. vol. LXXVIII. from the cold produced by the expanſion of air. For a thermometer placed in the receiver, ſinks ſome degrees, and in a very little time; as ſoon as a ſufficient quantity of heat can be acquired from the ſurrounding bodies, the dew becomes again taken up. See additional notes, No. VII. Mr. Sauſſure obſerved, on placing his hygrometer in a receiver of an air-pump, that though, on beginning to exhauſt it, the air became miſty, and parted with its moiſture, yet the hair of his hygrometer contracted, and the inſtrument pointed to greater dryneſs. This unexpected occurrence is explained by M. Monge, (Annales de Chimie, Tom. V.) to depend on the want of the uſual preſſure of the atmoſphere, to force the aqueous particles into the pores of the hair; and M. Sauſſure ſuppoſes, that his veſicular vapour requires more time to be re-diſſolved, than is neceſſary to dry the hair of his thermometer. Eſſais ſur l'Hygrom. p. 226. But I ſuſpect there is a leſs hypothetical way of underſtanding it: when a colder body is brought into warm and moiſt air, (as a bottle of ſpring-water, for inſtance,) a ſteam is quickly collected on its ſurface: the contrary occurs when a warmer body is brought into cold and damp air; it continues free from dew ſo long as it continues warm; for it warms the atmoſphere around it, and renders it capable of receiving, inſtead of parting with moiſture. The moment the air becomes rarefied in the receiver of the air-pump, it becomes colder, as appears by the thermometer, and depoſits its vapour; but the hair of Mr. Sauſſure's hygrometer is now warmer than the air in which it is immerſed, and, in conſequence, becomes dryer than before, by warming the air which immediately ſurrounds it, a part of its moiſture evaporating along with its heat.

Outſtretch'd his buoyant ball with airy ſpring, 145
And bore the Sage on levity of wing;—
Where were ye, *Sylphs!* when on the ethereal main
Young Rosiere launch'd, and call'd your aid in vain?
Fair mounts the light balloon, by Zephyr driven,
Parts the thin clouds, and ſails along the heaven; 150
Higher and yet higher the expanding bubble flies,
Lights with quick flaſh, and burſts amid the ſkies.—
Headlong He ruſhes through the affrighted Air
With limbs diſtorted, and diſhevel'd hair,
Whirls round and round, the flying croud alarms, 155
And *Death* receives him in his ſable arms!
—Betrothed Beauty, bending o'er his bier,
Breathes the loud ſob, and ſheds the inceſſant tear;
Purſues the ſad proceſſion, as it moves
Through winding avenues and waving groves; 160
Hears the ſlow dirge amid the echoing ailes,
And mingles with her ſighs diſcordant ſmiles.
Then with quick ſtep advancing through the gloom,
"I come!" ſhe cries, and leaps into his tomb.
"Oh, ſtay! I follow thee to realms above!— 165
"Oh, wait a moment for thy dying love!—
"Thus, thus I claſp thee to my burſting heart!—
"Cloſe o'er us, holy Earth!—We will not part!"*—
So erſt with melting wax and looſen'd ſtrings
Sunk hapleſs Icarus on unfaithful wings; 170
His ſcatter'd plumage danced upon the wave,
And ſorrowing Mermaids deck'd his watery grave;

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*Young Roſiere launch'd.* l. 148. M. Pilatre du Roſiere, with a M. Romain, roſe in a balloon from Boulogne, in June, 1785, and after having been about a mile high for about half an hour, the balloon took fire, and the two adventurers were daſhed to pieces on their fall to the ground. Mr. Roſiere was a philoſopher of great talents and activity, joined with ſuch urbanity and elegance of manners, as conciliated the affections of his acquaintance, and rendered his misfortune univerſally lamented. Annual Regiſter for 1784 and 1785, p. 329.

[*] Miſs Suſan Dyer was engaged, in a few days, to marry M. Roſiere, who had promiſed to quit ſuch dangerous experiments in future:—ſhe was ſpectatreſs of this ſad accident, lingered ſome months, and died from exceſs of grief. The Rev. Mr. *Collier*, Dean of Trinity College, in Cambridge, was well acquainted with this amiable young lady, and ſuggeſted the introduction of her melancholy hiſtory in this place.

O'er his pale corſe their pearly ſea-flowers ſhed,
And ſtrew'd with crimſon moſs his marble bed;
Struck in their coral towers the pauſing bell, 175
And wide in ocean toll'd his echoing knell.

V. " *Sylphs! you*, retiring to ſequeſter'd bowers,
Where oft your PRIESTLEY woos your airy powers,

*And wide in ocean.* l. 176. Denſer bodies propagate vibration or ſound better than rarer ones; if two ſtones be ſtruck together under the water, they may be heard a mile or two by any one whoſe head is immerſed at that diſtance, according to an experiment of Dr. Franklin. If the ear be applied to one end of a long beam of timber, the ſtroke of a pin at the other end becomes ſenſible; if a poker be ſuſpended in the middle of a garter, each end of which is preſſed againſt the ear, the leaſt percuſſions on the poker give great ſounds. And, I am informed, by laying the ear on the ground, the tread of a horſe may be diſcerned at a great diſtance in the night. The organs of hearing belonging to fiſh, are for this reaſon much leſs complicated than of quadrupeds, as the fluid they are immerſed in ſo much better conveys its vibrations. And, it is probable, that ſome ſhell-fiſh which have twiſted ſhells, like the cochlea, and ſemicircular canals of the ears of men and quadrupeds, may have no appropriated organ for perceiving the vibrations of the element they live in, but may, by their ſpiral form, be, in a manner, all ear.

*Where oft your Prieſtley.* l. 178. The fame of Dr. Prieſtley is known in every part of the earth where ſcience has penetrated. His various diſcoveries reſpecting the analyſis of the atmoſphere, and the production of a variety of new airs or gaſſes, can only be clearly underſtood by reading his Experiments on Airs, (3 vols. octavo. Johnſon. Lond.) The following are amongſt his many diſcoveries. 1. The diſcovery of nitrous and dephlogiſticated airs. 2. The exhibition of the acids and alkalies in the form of air. 3. Aſcertaining the purity of reſpirable air by nitrous air. 4. The reſtoration of vitiated air by vegetation. 5. The influence of light to enable vegetables to yield pure air. 6. The converſion, by means of light, of animal and vegetable ſubſtances, that would otherwiſe become putrid and offenſive, into nouriſhment of vegetables. 7. The uſe of reſpiration by the blood parting with phlogiſton, and imbibing dephlogiſticated air.

The experiments here alluded to are, 1. Concerning the production of nitrous gas from diſſolving iron, and many other metals in nitrous acid, which, though firſt diſcovered by Dr. Hales, (Static. Eſſ. vol. I. p. 224,) was fully inveſtigated, and applied to the important purpoſe of diſtinguiſhing the purity of atmoſpheric air by Dr. Prieſtley. When about two meaſures of common air, and one of nitrous gas, are mixed together, a red efferveſcence takes place, and the two airs occupy about one-fourth leſs ſpace than was previouſly occupied by the common air alone.

2. Concerning the green ſubſtance which grows at the bottom of reſervoirs of water, which Dr. Prieſtley diſcovered to yield much pure air when the ſun ſhone on it. His method of collecting this air is by placing over the green ſubſtance, which he believes to be a vegetable of the genus conferva, an inverted bell-glaſs previouſly filled with water, which ſubſides as the air ariſes; it has ſince been found that all vegetables give up pure air

On noiſeleſs ſtep or quivering pinion glide,
As ſits the Sage with Science by his ſide;
To his charm'd eye in gay undreſs appear,
Or pour your ſecrets on his raptured ear.
How nitrous Gas from iron ingots driven
Drinks with red lips the pureſt breath of heaven;
How, while Conferva, from its tender hair,
Gives in bright bubbles empyrean air,
The cryſtal floods phlogiſtic ores calcine,
And the pure Ether marries with the Mine.

" So in Sicilia's ever-blooming ſhade,
When playful Proserpine from Ceres ſtray'd,
Led with unwary ſtep her virgin trains
O'er Etna's ſteeps, and Enna's golden plains;
Pluck'd with fair hand the ſilver-bloſſom'd bower,
And purpled mead,—herſelf a fairer flower;
Sudden, unſeen amid the twilight glade,
Ruſh'd gloomy Dis, and ſeized the trembling maid.—
Her ſtarting damſels ſprung from moſſy ſeats,
Dropp'd from their gauzy laps the gather'd ſweets,
Clung round the ſtruggling Nymph, with piercing cries,
Purſued the chariot, and invok'd the ſkies;—

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from their leaves, when the ſun ſhines upon them, but not in the night, which may be owing to the ſleep of the plant.

3. The third refers to the great quantity of pure air contained in the calces of metals. The calces were long known to weigh much more than the metallic bodies before calcination, inſomuch that 100 pounds of lead will produce 112 pounds of minium; the ore of manganeſe, which is always found near the ſurface of the earth, is replete with pure air, which is now uſed for the purpoſe of bleaching. Other metals, when expoſed to the atmoſphere, attract the pure air from it, and become calces by its combination, as zink, lead, iron; and increaſe in weight in proportion to the air which they imbibe.

*When playful Proſerpine.* l. 190. The fable of Proſerpine's being ſeized by Pluto as ſhe was gathering flowers, is explained by Lord Bacon to ſignify the combination or marriage of ethereal ſpirit with earthly materials. Bacon's Works, vol. V. p. 470. edit. 4to. Lond. 1778. This alluſion is ſtill more curiouſly exact, from the late diſcovery of pure air being given up from vegetables, and that then, in its unmixed ſtate, it more readily combines with metallic or inflammable bodies. From theſe fables, which were probably taken from ancient hieroglyphics, there is frequently reaſon to believe, that the Egyptians poſſeſſed much chemical knowledge, which, for want of alphabetical writing, periſhed with their philoſophers.

Pleaſed as he graſps her in his iron arms,
Frights with ſoft ſighs, with tender words alarms,
The wheels deſcending roll'd in ſmoky rings,
Infernal Cupids flapp'd their demon wings;
Earth with deep yawn received the Fair, amaz'd,
And far in Night celeſtial Beauty blaz'd.

VI. "Led by the Sage, lo! Britain's ſons ſhall guide
Huge *Sea-Balloons* beneath the toſſing tide;
The diving caſtles, roof'd with ſpheric glaſs,
Ribb'd with ſtrong oak, and barr'd with bolts of braſs,
Buoy'd with pure air ſhall endleſs tracks purſue,
And PRIESTLEY's hand the vital flood renew.—
Then ſhall BRITANNIA rule the wealthy realms,
Which Ocean's wide inſatiate wave o'erwhelms;
Confine in netted bowers his ſcaly flocks,
Part his blue plains, and people all his rocks.
Deep, in warm waves beneath the Line that roll,
Beneath the ſhadowy ice-iſles of the Pole,
Onward, through bright meandering vales, afar,
Obedient Sharks ſhall trail her ſceptred car,
With harneſs'd necks the pearly flood diſturb,
Stretch the ſilk rein, and champ the ſilver curb;

*Led by the Sage.* l. 207. Dr. Prieſtley's diſcovery of the production of pure air from ſuch variety of ſubſtances will probably ſoon be applied to the improvement of the diving-bell, as the ſubſtances which contain vital air in immenſe quantities are of little value, as manganeſe and minium. See additional notes, No. XXXIII. In every hundred weight of minium there is combined about twelve pounds of pure air; now, as ſixty pounds of water are about a cubic foot, and as air is eight hundred times lighter than water, five hundred weight of minium will produce eight hundred cubic feet of air, or about ſix thouſand gallons. Now, as this is at leaſt thrice as pure as atmoſpheric air, a gallon of it may be ſuppoſed to ſerve for three minutes reſpiration for one man. At preſent the air can not be ſet at liberty from minium, by vitriolic acid, without the application of ſome heat; this is, however, very likely ſoon to be diſcovered, and will then enable adventurers to journey beneath the ocean in large inverted ſhips, or diving balloons.

Mr. Boyle relates, that Cornelius Drebelle contrived not only a veſſel to be rowed under water, but alſo a liquor to be carried in that veſſel which would ſupply the want of freſh air. The veſſel was made by order of James I. and carried twelve rowers beſides paſſengers. It was tried in the river Thames, and one of the perſons who was in that ſubmarine voyage, told the particulars of the experiments to a perſon who related them to Mr. Boyle. Annual Regiſter for 1774, p. 248.

Pleaſed round her triumph wondering Tritons play,
And Sea-maids hail her on the watery way.
—Oft ſhall ſhe weep beneath the cryſtal waves
O'er ſhipwreck'd lovers weltering in their graves;
Mingling in death the Brave and Good behold
With ſlaves to glory, and with ſlaves to gold;
Shrin'd in the deep ſhall DAY and SPALDING mourn,
Each in his treacherous bell, ſepulchral urn!—
Oft o'er thy lovely daughters, hapleſs PIERCE!
Her ſighs ſhall breathe, her ſorrows dew their hearſe.—
With brow upturn'd to Heaven, "*We will not part!*"
He cried, and claſp'd them to his aching heart.—
—Daſh'd in dread conflict on the rocky grounds,
Craſh the ſhock'd maſts, the ſtaggering wreck rebounds;
Through gaping ſeams the ruſhing deluge ſwims,
Chills their pale boſoms, bathes their ſhuddering limbs,
Climbs their white ſhoulders, buoys their ſtreaming hair,
And the laſt ſea-ſhriek bellows in the air.—

*Day and Spalding mourn.* l. 229. Mr. Day periſhed in a diving-bell, or diving-boat, of his own conſtruction, at Plymouth, in June, 1774, in which he was to have continued, for a wager, twelve hours, one hundred feet deep in water, and probably periſhed from his not poſſeſſing all the hydroſtatic knowledge that was neceſſary. See note on Ulva, vol. II. of this work. See Annual Regiſter for 1774, p. 245.

Mr. Spalding was profeſſionally ingenious in the art of conſtructing and managing the diving-bell, and had practiſed the buſineſs many years with ſucceſs. He went down, accompanied by one of his young men, twice, to view the wreck of the Imperial Eaſt-Indiaman, at the Kiſh bank, in Ireland. On deſcending the third time, in June, 1783, they remained about an hour under water, and had two barrels of air ſent down to them; but, on the ſignals from below not being again repeated, after a certain time, they were drawn up by their aſſiſtants, and both found dead in the bell. Annual Regiſter for 1783, p. 206. Theſe two unhappy events may, for a time, check the ardor of adventurers in traverſing the bottom of the ocean; but, it is probable, in another half century it may be ſafer to travel under the ocean than over it, ſince Dr. Prieſtley's diſcovery of procuring pure air in ſuch great abundance from the calces of metals.

*Hapleſs Pierce!* l. 231. The Halſewell, Eaſt-Indiaman, outward bound, was wrecked off Seacomb, in the Iſle of Purbec, on the 6th of January, 1786, when Capt. Pierce, the commander, with two young ladies, his daughters, and the greateſt part of the crew and paſſengers, periſhed in the ſea. Some of the officers, and about ſeventy ſeamen, eſcaped with great difficulty on the rocks; but Capt. Pierce, finding it was impoſſible to ſave the lives of the young ladies, refuſed to quit the ſhip, and periſhed with them.

Each with loud ſobs her tender ſire careſs'd,
And gaſping ſtrain'd him cloſer to her breaſt!—
—Stretch'd on one bier they ſleep beneath the brine,
And their white bones with ivory arms intwine!

VII. "*Sylphs of nice ear!* with beating wings *you* guide
The fine vibrations of the aerial tide;
Join in ſweet cadences the meaſured words,
Or ſtretch and modulate the trembling cords.
*You* ſtrung to melody the Grecian lyre,
Breathed the rapt ſong, and fan'd the thought of fire,
Or brought in combinations, deep and clear,
Immortal harmony to HANDEL's ear.—
*You* with ſoft breath attune the vernal gale,
When breezy evening broods the liſtening vale;
Or wake the loud tumultuous ſounds, that dwell
In Echo's many-toned diurnal ſhell.
*You* melt in dulcet chords, when Zephyr rings
The Eolian Harp, and mingle all its ſtrings;
Or trill in air the ſoft ſymphonious chime,
When rapt CECILIA lifts her eye ſublime,
Swell, as ſhe breathes, her boſom's riſing ſnow,
O'er her white teeth in tuneful accents flow,
Through her fair lips on whiſpering pinions move,
And form the tender ſighs, that kindle love!

"So playful *Love* on Ida's flowery ſides
With ribbon-rein the indignant Lion guides;
Pleaſed on his brinded back the lyre he rings,
And ſhakes delirious rapture from the ſtrings;
Slow as the pauſing Monarch ſtalks along,
Sheaths his retractile claws, and drinks the ſong;
Soft Nymphs on timid ſtep the triumph view,
And liſtening Fawns with beating hoofs purſue;
With pointed ears the alarmed foreſt ſtarts,
And Love and Muſic ſoften ſavage hearts.

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*Indignant Lion guides.* l. 266. Deſcribed from an ancient gem, expreſſive of the combined power of love and muſic, in the Muſeum Florent.

VIII. "*Sylphs! your* bold hoſts, when Heaven with juſtice dread
Calls the red tempeſt round the guilty head,
Fierce at his nod aſſume vindictive forms,
And launch from airy cars the vollied ſtorms.—
From Aſhur's vales when proud SENACHERIB trod,
Pour'd his ſwoln heart, defied the living GOD,
Urg'd with inceſſant ſhouts his glittering powers,
And JUDAH ſhook through all her maſſy towers;
Round her ſad altars preſs'd the proſtrate crowd,
Hoſts beat their breaſts, and ſuppliant chieftains bow'd;
Loud ſhrieks of matrons thrill'd the troubled air,
And trembling virgins rent their ſcatter'd hair;
High in the midſt the kneeling King adored,
Spread the blaſpheming ſcroll before the Lord,
Raiſed his pale hands, and breathed his pauſing ſighs,
And fixed on Heaven his dim imploring eyes,—
"Oh! MIGHTY GOD! amidſt thy Seraph-throng
"Who ſit'ſt ſublime, the Judge of Right and Wrong;
"Thine the wide earth, bright ſun, and ſtarry zone,
"That twinkling journey round thy golden throne;
"Thine is the cryſtal ſource of life and light,
"And thine the realms of Death's eternal night.
"Oh! bend thine ear, thy gracious eye incline,
"Lo! Aſhur's King blaſphemes thy holy ſhrine,
"Inſults our offerings, and derides our vows,—
"Oh! ſtrike the diadem from his impious brows,
"Tear from his murderous hand the bloody rod,
"And teach the trembling nations, *Thou art* GOD!"
—*Sylphs!* in what dread array with pennons broad
Onward ye floated o'er the ethereal road,
Call'd each dank ſteam the reeking marſh exhales,
Contagious vapours, and volcanic gales,

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*Volcanic gales.* l. 306. The peſtilential winds of the eaſt are deſcribed by various authors under various denominations, as harmattan, ſamiel, ſamium, ſyrocca, kamſin, ſeravanſum. M. de Beauchamp deſcribes a remarkable ſouth wind in the deſerts about Bagdad, called ſeravanſum, or poiſon wind; it burns the face, impedes reſpiration, ſtrips the trees of their leaves, and is ſaid to paſs on in a ſtraight line, and often kills people in ſix hours. P. Cotte ſur la Meteorol. Analytical Review for February, 1790. M. Vol-

Gave the ſoft South with poiſonous breath to blow,
And roll'd the dreadful whirlwind on the foe!
Hark! o'er the camp the venom'd tempeſt ſings,
Man falls on Man, on buckler buckler rings;
Groan anſwers groan, to anguiſh anguiſh yields,
And Death's loud accents ſhake the tented fields!
—High rears the Fiend his grinning jaws, and wide
Spans the pale nations with coloſſal ſtride,
Waves his broad falchion with uplifted hand,
And his vaſt ſhadow darkens all the land.

IX. 1. "Ethereal Cohorts! Eſſences of Air!
Make the green children of the Spring your care!
Oh, *Sylphs!* diſcloſe in this inquiring age
One *golden ſecret* to ſome favour'd ſage;
Grant the charm'd taliſman, the chain, that binds,
Or guides the changeful pinions of the winds!

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ney ſays, the hot wind, or ramſin, ſeems to blow at the ſeaſon when the ſands of the deſerts are the hotteſt; the air is then filled with an extremely ſubtle duſt. Vol. I. p. 61. Theſe winds blow in all directions from the deſerts; in Egypt the moſt violent proceed from the S. S. W. at Mecca, from the E. at Surat, from the N. at Baſſora, from the N. W. at Bagdad, from the W. and in Syria, from the S. E.

On the ſouth of Syria, he adds, where the Jordan flows, is a country of volcanos; and it is obſerved, that the earthquakes in Syria happen after their rainy ſeaſon, which is alſo conformable to a ſimilar obſervation made by Dr. Shaw, in Barbary. Travels in Egypt, vol. I. p. 303.

Theſe winds ſeem all to be of volcanic origin, as before mentioned, with this difference, that the ſimoom is attended with a ſtream of electric matter; they ſeem to be in conſequence of earthquakes cauſed by the monſoon floods, which fall on volcanic fires in Syria, at the ſame time that they inundate the Nile.

*One golden ſecret.* l. 320. The ſuddenneſs of the change of the wind from N. E. to S. W. ſeems to ſhew that it depends on ſome minute chemical cauſe, which, if it was diſcovered, might probably, like other chemical cauſes, be governed by human agency, ſuch as blowing up rocks by gun-powder, or extracting the lightning from the clouds. If this could be accompliſhed, it would be the moſt happy diſcovery that ever has happened in theſe northern latitudes, ſince in this country the N. E. winds bring froſt, and the S W. ones are attended with warmth and moiſture; if the inferior currents of air could be kept perpetually from the S. W. ſupplied by new productions of air at the line, or by ſuperior currents flowing in a contrary direction, the vegetation of this country would be doubled, as in the moiſt vallies of Africa, which know no froſt; the number of its inhabitants would be increaſed, and their lives prolonged; as great abundance of the aged and infirm of mankind, as well as many birds and animals, are deſtroyed by ſevere continued froſts in this climate.

—No more ſhall hoary Boreas, iſſuing forth
With Eurus, lead the tempeſts of the North;
Rime the pale Dawn, or veil'd in flaky ſhowers
Chill the ſweet boſoms of the ſmiling Hours.
By whiſpering Auſter waked ſhall Zephyr riſe,
Meet with ſoft kiſs, and mingle in the ſkies,
Fan the gay floret, bend the yellow ear,
And rock the uncurtain'd cradle of the year;
Autumn and Spring in lively union blend,
And from the ſkies the golden Age deſcend.

2. "Caſtled on ice, beneath the circling Bear,
A vaſt Camelion drinks and vomits air;
O'er twelve degrees his ribs gigantic bend,
And many a league his gaſping jaws extend;
Half-fiſh, beneath, his ſcaly volutes ſpread,
And vegetable plumage creſts his head;
Huge fields of air his wrinkled ſkin receives,
From panting gills, wide lungs, and waving leaves;
Then with dread throes ſubſides his bloated form,
His ſhriek the thunder, and his ſigh the ſtorm.
Oft high in heaven the hiſſing Demon wins
His towering courſe, upborne on winnowing fins;
Steers with expanded eye and gaping mouth,
His maſs enormous to the affrighted South;
Spreads o'er the ſhuddering Line his ſhadowy limbs,
And Froſt and Famine follow as he ſwims.—
*Sylphs!* round his cloud-built couch your bands array,
And mould the Monſter to your gentle ſway;
Charm with ſoft tones, with tender touches check,
Bend to your golden yoke his willing neck,
With ſilver curb his yielding teeth reſtrain,
And give to Kirwan's hand the ſilken rein.

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*A vaſt Camelion.* l. 334. See additional notes, No. XXXIII. on the deſtruction and re-production of the atmoſphere.

*To Kirwan's hand.* l. 354. Mr. Kirwan has publiſhed a valuable treatiſe on the temperature of climates, as a ſtep towards inveſtigating the theory of the winds, and has ſince written ſome ingenious papers on this ſubject, in the Tranſactions of the Royal Iriſh Society.

—Pleaſed ſhall the Sage, the dragon-wings between,
Bend o'er diſcordant climes his eye ſerene,
With Lapland breezes cool Arabian vales,
And call to Hindoſtan antarctic gales,
Adorn with wreathed ears Kampſchatca's brows,
And ſcatter roſes on Zealandic ſnows,
Earth's wondering Zones the genial ſeaſons ſhare,
And nations hail him "*Monarch of the Air.*"

X. 1. "*Sylphs!* as you hover on ethereal wing,
Brood the green children of parturient Spring!—
Where in their burſting cells my Embryons reſt,
I charge you, guard the vegetable neſt;
Count with nice eye the myriad *Seeds*, that ſwell
Each vaulted womb of huſk, or pod, or ſhell;
Feed with ſweet juices, clothe with downy hair,
Or hang, inſhrined, their little orbs in air.

"So, late deſcry'd by Herschel's piercing ſight,
Hang the bright ſquadrons of the twinkling Night;
Ten thouſand marſhal'd ſtars, a ſilver zone,
Effuſe their blended luſtres round her throne;
Suns call to ſuns, in lucid clouds conſpire,
And light exterior ſkies with golden fire;

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*The myriad ſeeds.* l. 367. Nature would ſeem to have been wonderfully prodigal in the ſeeds of vegetables, and the ſpawn of fiſh; almoſt any one plant, if all its ſeeds ſhould grow to maturity, would, in a few years, alone people the terreſtrial globe. Mr. Ray aſſerts that 1012 ſeeds of tobacco weighed only one grain, and that from one tobacco plant the ſeeds thus calculated amounted to 360,000. The ſeeds of the ferns are by him ſuppoſed to exceed a million on a leaf. As the works of nature are governed by general laws, this exuberant re-production prevents the accidental extinction of the ſpecies, at the ſame time that they ſerve for food for the higher orders of animation.

Every ſeed poſſeſſes a reſervoir of nutriment deſigned for the growth of the future plant; this conſiſts of ſtarch, mucilage, or oil, within the coat of the ſeed, or of ſugar and ſub-acid pulp in the fruit, which belongs to it.

For the preſervation of the immature ſeed, nature has uſed many ingenious methods; ſome are wrapped in down, as the ſeeds of the roſe, bean, and cotton-plant; others are ſuſpended in a large air-veſſel, as thoſe of the bladder-ſena, ſtaphylæa, and pea.

*And light exterior.* l. 376. I ſuſpect this line is from Dwight's Conqueſt of Canaan, a poem written by a very young man, and which contains much fine verſification.

Reſiſtleſs rolls the illimitable ſphere,
And one great circle forms the unmeaſured year.
—Roll on, *ye Stars!* exult in youthful prime,
Mark with bright curves the printleſs ſteps of Time;
Near and more near your beamy cars approach,
And leſſening orbs on leſſening orbs encroach;—
Flowers of the ſky! ye too to age muſt yield,
Frail as your ſilken ſiſters of the field!
Star after ſtar from Heaven's high arch ſhall ruſh,
Suns ſink on ſuns, and ſyſtems ſyſtems cruſh,
Headlong, extinct, to one dark centre fall,
And Death, and Night, and Chaos mingle all!
—Till o'er the wreck, emerging from the ſtorm,
Immortal Nature lifts her changeful form,
Mounts from her funeral pyre on wings of flame,
And ſoars and ſhines, another and the ſame.

2. "Lo! on each *Seed* within its ſlender rind
Life's golden threads in endleſs circles wind;
Maze within maze the lucid webs are roll'd,
And, as they burſt, the living flame unfold.

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*Near and more near.* l. 381. From the vacant ſpaces in ſome parts of the heavens, and the correſpondent cluſters of ſtars in their vicinity, Mr. Herſchel concludes that the nebulæ, or conſtellations of fixed ſtars, are approaching each other, and muſt finally coaleſce in one maſs. Phil. Tranſ. vol. LXXV.

*Till o'er the wreck.* l. 389. The ſtory of the phenix riſing from its own aſhes, with a twinkling ſtar upon its head, ſeems to have been an ancient hieroglyphic emblem of the deſtruction and reſuſcitation of all things.

There is a figure of the great Platonic year, with a phenix on his hand, on the reverſe of a medal of Adrian. Spence's Polym. p. 189.

*Maze within maze.* l. 395. The elegant appearance, on diſſection, of the young tulip in the bulb, was firſt obſerved by Mariotte, and is mentioned in the note on tulipa, in vol. II. and was afterwards noticed by Du Hamel. Acad. Scien. Lewenhoeck aſſures us, that in the bud of a currant-tree he could not only diſcover the ligneous part, but even the berries themſelves, appearing like ſmall grapes. Chamb. Dict. art. Bud. Mr. Baker ſays he diſſected a ſeed of trembling graſs in which a perfect plant appeared, with its root ſending forth two branches, from each of which ſeveral leaves, or blades of graſs, proceeded. Microſc. vol. I. p. 252. Mr. Bonnet ſaw four generations of ſucceſſive plants in the bulb of a hyacinth. Bonnet Corps Organ. vol. I. p. 103. Haller's Phyſiol. vol. I. p. 91. In the terminal bud of a horſe-cheſnut the new flower may be ſeen by the naked eye, covered with a mucilaginous down, and the ſame in the bulb of a narciſſus,

The pulpy acorn, ere it ſwells, contains
The Oak's vaſt branches in its milky veins:
Each ravel'd bud, fine film, and fibre-line
Traced with nice pencil on the ſmall deſign.
The young Narciſſus, in its bulb compreſs'd,
Cradles a ſecond neſtling on its breaſt;
In whoſe fine arms a younger embryon lies,
Folds its thin leaves, and ſhuts its floret-eyes;
Grain within grain ſucceſſive harveſts dwell,
And boundleſs foreſts ſlumber in a ſhell.
—So yon grey precipice, and ivy'd towers,
Long winding meads, and intermingled bowers,
Green files of poplars, o'er the lake that bow,
And glimmering wheel, which rolls and foams below,
In one bright point with nice diſtinction lie
Plann'd on the moving tablet of the eye.
—So, fold on fold, Earth's wavy plains extend,
And, ſphere in ſphere, its hidden ſtrata bend;—
Incumbent Spring her beamy plumes expands
O'er reſtleſs oceans, and impatient lands,
With genial luſtres warms the mighty ball,
And the GREAT SEED evolves, diſcloſing All;
LIFE *buds* or *breathes* from Indus to the Poles,
And the vaſt ſurface kindles as it rolls!

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as I this morning obſerved in ſeveral of them ſent me by Miſs ———, for that purpoſe. Sept. 16.

Mr. Ferber ſpeaks of the pleaſure he received in obſerving in the buds of hepatica and pedicularis hirſuta, yet lying hid in the earth, and in the germs of the ſhrub daphne mezereon, and at the baſe of oſmunda lunaria, a perfect plant of the future year, diſcernible in all its parts a year before it comes forth; and in the ſeeds of nymphea nelumbo, the leaves of the plant were ſeen ſo diſtinctly that the author found out by them what plant the ſeeds belonged to. The ſame of the ſeeds of the tulip-tree, or liriodendron tulipiferum. Amæn. Acad. vol. VI.

*And the great ſeed.* l. 418. Alluding to the πϱοτον ωον, or firſt great egg of the ancient philoſophy; it had a ſerpent wrapped round it, emblematical of divine wiſdom; an image of it was afterwards preſerved, and worſhipped in the temple of Dioſcuri, and ſuppoſed to repreſent the egg of Leda. See a print of it in Bryant's Mythology. It was ſaid to have been broken by the horns of the celeſtial bull; that is, it was hatched by the warmth of the ſpring. See note on Canto I. l. 413.

*And the vaſt ſurface.* l. 420. L'Organization, le ſentiment, le movement ſpontané, la vie, n'exiſtent qu'à la ſurface de la terre, et dans le lieux expoſés à la lumiére. Traité de Chymie par M. Lavoiſier, Tom. I. p. 202.

3. "Come, *ye ſoft Sylphs!* who ſport on Latian land,
Come, ſweet-lip'd Zephyr, and Favonius bland!
Teach the fine *Seed*, inſtinct with life, to ſhoot
On Earth's cold boſom its deſcending root;
With Pith elaſtic ſtretch its riſing ſtem,
Part the twin Lobes, expand the throbbing Gem;
Claſp in your airy arms the aſpiring Plume,
Fan with your balmy breath its kindling bloom,
Each widening ſcale and burſting film unfold,
Swell the green cup, and tint the flower with gold;
While in bright veins the ſilvery Sap aſcends,
And refluent blood in milky eddies bends;
While, ſpread in air, the leaves reſpiring play,
Or drink the golden quinteſſence of day.

*Teach the fine ſeed.* l. 423. The ſeeds, in their natural ſtate, fall on the ſurface of the earth, and, having abſorbed ſome moiſture, the root ſhoots itſelf downwards into the earth, and the plume riſes in air. Thus each endeavouring to ſeek its proper pabulum, directed by a vegetable irritability ſimilar to that of the lacteal ſyſtem, and to the lungs in animals.

The pith ſeems to puſh up or elongate the bud by its elaſticity, like the pith in the callow quills of birds. This medulla Linnæus believes to conſiſt of a bundle of fibres, which, diverging, breaks through the bark, yet gelatinous, producing the buds.

The lobes are reſervoirs of prepared nutriment for the young ſeed, which is abſorbed by its placental veſſels, and converted into ſugar, till it has penetrated with its roots far enough into the earth to extract ſufficient moiſture, and has acquired leaves to convert it into nouriſhment. In ſome plants theſe lobes riſe from the earth, and ſupply the place of leaves, as in kidney-beans, cucumbers; and hence ſeem to ſerve both as a placenta to the fœtus, and lungs to the young plant. During the proceſs of germination, the ſtarch of the ſeed is converted into ſugar, as is ſeen in the proceſs of malting barley for the purpoſe of brewing. And is, on this account, very ſimilar to the digeſtion of food in the ſtomachs of animals, which converts all their aliment into a chyle, which conſiſts of mucilage, oil, and ſugar: the placentation of buds will be ſpoken of hereafter.

*The ſilvery ſap.* l. 431. See additional notes, No. XXXV.

*And refluent blood.* l. 432. See additional notes, No. XXXVI.

*The leaves reſpiring play.* l. 433. See additional notes, No. XXXVII.

*Or drink the golden.* l. 434. Linnæus, having obſerved the great influence of light on vegetation, imagined that the leaves of plants inhaled electric matter from the light with their upper ſurface. (Syſtem of Vegetables tranſlated, p. 8.)

The effect of light on plants occaſions the actions of the vegetable muſcles of their leaf-ſtalks, which turn the upper ſide of the leaf to the light, and which open their calyxes and corols, according to the experiments of Abbe Teſſier, who expoſed variety of plants, in a cavern, to different quantities of light. Hiſt. de L'Academie Royal. Ann. 1783. The ſleep or vigilance of plants ſeems owing to the preſence or abſence of this ſtimulus. See note on Mimoſa, Part II.

—So from his ſhell on Delta's ſhower-leſs iſle
Burſts into life the Monſter of the Nile;
Firſt in tranſlucent lymph with cobweb-threads
The Brain's fine floating tiſſue ſwells, and ſpreads;
Nerve after nerve the gliſtening ſpine deſcends,
The red Heart dances, the Aorta bends;
Through each new gland the purple current glides,
New Veins meandering drink the refluent tides;
Edge o'er edge expands the hardening ſcale,
And ſheaths his ſlimy ſkin in ſilver mail.
—Erewhile, emerging from the brooding ſand,
With Tyger-paw He prints the brineleſs ſtrand,
High on the flood with ſpeckled boſom ſwims,
Helm'd with broad tail, and oar'd with giant limbs;
Rolls his fierce eye-balls, claſps his iron claws,
And champs with gnaſhing teeth his maſſy jaws;
Old Nilus ſighs along his cane-crown'd ſhores,
And ſwarthy Memphis trembles and adores.

XI. "Come, *ye ſoft Sylphs!* who fan the Paphian groves,
And bear on ſportive wings the callow Loves;
Call with ſweet whiſper, in each gale that blows,
The ſlumbering Snow-drop from her long repoſe;
Charm the pale Primroſe from her clay-cold bed,
Unveil the baſhful Violet's tremulous head;
While from her bud the playful Tulip breaks,
And young Carnations peep with bluſhing cheeks;
Bid the cloſed *Corol* from nocturnal cold
Curtain'd with ſilk the virgin *Stigma* fold,
Shake into viewleſs air the morning dews,
And wave in light its irideſcent hues.
So ſhall from high the burſting *Anther* truſt
To the mild breezes the prolific duſt;
Or bow his waxen head with graceful pride,
Watch the firſt bluſhes of his waking bride,
Give to her hand the honey'd cup, or ſip
Celeſtial nectar from her ſweeter lip;

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*Honey'd cup.* l. 469. The nectary, or honey-gland, ſupplies food to the vegetable males and females, which, like moths and butterflies, live on the

Hang in ſoft raptures o'er the yielding Fair,
Love out his hour, and leave his life in air.
So in his ſilken ſepulchre the Worm,
Warm'd with new life, unfolds his larva-form;
Erewhile aloft in wanton circles moves,
And woos on Hymen-wings his velvet loves.

XII. 1. " If prouder branches with exuberance rude
Point their green gems, their barren ſhoots protrude;
Wound them, ye *Sylphs!* with little knives, or bind
A wiry ringlet round the ſwelling rind;

honey thus produced for them, till they have propagated their ſpecies, and depoſited their eggs, and then die; as explained in additional note, No. XXXIX. The tops of the ſtamens, or anthers, are covered with wax, to protect the prolific duſt from the injury of ſhowers and dews, to which it is impervious.

*Love out his hour.* l. 472. The vegetable paſſion of love is agreeably ſeen in the flower of the parnaſſia, in which the males alternately approach and recede from the female, and in the flower of nigella, or devil in the buſh, in which the tall females bend down to their dwarf huſbands. But I was this morning ſurpriſed to obſerve, amongſt Sir Brooke Boothby's valuable collection of plants at Aſhbourn, the manifeſt adultery of ſeveral females of the plant Collinſonia, who had bent themſelves into contact with the males of other flowers of the ſame plant in their vicinity, neglectful of their own. Sept. 16. See additional notes, No. XXXVIII.

*Unfolds his larva-form.* l. 474. The flower burſts forth from its larva, the herb, naked and perfect like a butterfly from its chryſalis; winged with its corol; wing-ſheathed by its calyx; conſiſting alone of the organs of reproduction. The males, or ſtamens, have their anthers replete with a prolific powder, containing the vivifying fovilla; in the females, or piſtils, exiſts the ovary, terminated by the tubular ſtigma. When the anthers burſt and ſhed their bags of duſt, the male fovilla is received by the prolific lymph of the ſtigma, and produces the ſeed or egg, which is nouriſhed in the ovary. Syſtem of Vegetables, tranſlated from Linnæus by the Lichfield Society. p. 10.

*Wound them, ye Sylphs.* l. 479. Mr. Whitmill adviſed to bind ſome of the moſt vigorous ſhoots with ſtrong wire, and even ſome of the large roots; and Mr. Warner cuts what he calls a wild worm about the body of the tree, or ſcores the bark quite to the wood, like a ſcrew, with a ſharp knife. Bradley on Gardening, vol. II. p. 155. Mr. Fitzgerald produced flowers and fruit on wall-trees by cutting off a part of the bark. Phil. Tranſ. Ann. 1761. M. Buffon produced the ſame effect by a ſtraight bandage put round a branch, Act. Paris, Ann. 1738, and concludes that an ingrafted branch bears better from its veſſels being compreſſed by the callus.

A complete cylinder of the bark, about an inch in height, was cut off from the branch of a pear-tree, againſt a wall, in Mr. Howard's garden, at Lichfield, about five years ago; the circumciſed part is now not above half the diameter of the branch above and below it, yet this branch has been full of fruit every year ſince, when the other branches of the tree bore only

iſect with chiſſel fine the root below,
r bend to earth the inhoſpitable bough.
o ſhall each Germ with new prolific power
elay the leaf-bud, and expand the flower;

aringly. I lately obſerved that the leaves of this wounded branch were naller and paler, and the fruit leſs in ſize, and ripened ſooner than on the ther parts of the tree. Another branch has the bark taken off not quite all ound, with much the ſame effect.

The theory of this curious vegetable fact has been eſteemed difficult, but eceives great light from the foregoing account of the individuality of buds. A flower-bud dies, when it has perfected its ſeed, like an annual plant, and ence requires no place on the bark for new roots to paſs downwards; but, n the contrary, leaf-buds, as they advance into ſhoots, form new buds in he axilla of every leaf, which new buds require new roots to paſs down the ark, and thus thicken as well as elongate the branch: now, if a wire or ſtring be tied round the bark, many of theſe new roots cannot deſcend, and thence more of the buds will be converted into flower-buds.

It is cuſtomary to debark oak-trees in the ſpring, which are intended to be felled in the enſuing autumn, becauſe the bark comes off eaſier at this ſeaſon, and the ſap-wood, or alburnum, is believed to become harder and more durable, if the tree remains till the end of ſummer. The trees, thus ſtripped of their bark, put forth ſhoots as uſual, with acorns, on the 6th, 7th, and 8th joint, like vines; but in the branches I examined, the joints of the debarked trees were much ſhorter than thoſe of other oak-trees; the acorns were more numerous; and no new buds were produced above the joints which bore acorns. From hence it appears that the branches of debarked oak-trees produce fewer leaf-buds, and more flower-buds, which laſt circumſtance, I ſuppoſe, muſt depend on their being ſooner or later debarked in the vernal months. And, ſecondly, that the new buds of debarked oak-trees continue to obtain moiſture from the alburnum, after the ſeaſon of the aſcent of ſap in other vegetables ceaſes; which, in this unnatural ſtate of the debarked tree, may act as capillary tubes, like the alburnum of the ſmall debarked cylinder of a pear-tree above-mentioned; or may continue to act as placental veſſels, as happens to the animal embryon in caſes of ſuperfetation; when the fœtus continues a month or two in the womb beyond its uſual time, of which ſome inſtances have been recorded, the placenta continues to ſupply, perhaps, the double office both of nutrition and of reſpiration.

*Or bend to earth.* l. 482. Mr. Hitt, in his treatiſe on fruit-trees, obſerves, that if a vigorous branch of a wall-tree be bent to the horizon, or beneath it, it loſes its vigour, and becomes a bearing branch. The theory of this I ſuppoſe to depend on the difficulty with which the leaf-ſhoots can protrude the roots neceſſary for their new progeny of buds upwards, along the bended branch, to the earth, contrary to their natural habits or powers, whence more flower-ſhoots are produced, which do not require new roots to paſs along the bark of the bended branch, but which let their offspring, the ſeeds, fall upon the earth, and ſeek roots for themſelves.

*With new prolific power.* l. 483. About Midſummer the new buds are formed, but it is believed by ſome of the Linnæan ſchool, that theſe buds may, in their early ſtate, be either converted into flower-buds or leaf-buds, according to the vigour of the vegetating branch. Thus, if the upper part of a branch be cut away, the buds near the extremity of the remaining ſtem,

Cloſed in the *Style* the tender Pith ſhall end, 485
The lengthening Wood in circling *Stamens* bend;
The ſmoother Rind its ſoft embroidery ſpread
In vaulted *Petals* o'er the gorgeous bed;
The wrinkled bark, in filmy mazes roll'd,
Form the green *Calyx*, fold including fold; 490
Each widening *Bracte* expand its foliage hard,
And hem the bright pavillion, *Floral Guard*.
—So the cold rill from Cintra's ſteepy ſides,
Headlong, abrupt, in barren channels glides;
Round the rent cliffs the bark-bound Suber ſpreads, 495
And lazy monks recline on corky beds;
Till, led by art, the wondering water moves
Through vine-hung avenues, and citron groves;
Green ſlopes the velvet round its ſilver ſource,
And flowers, and fruits, and foliage mark its courſe. 500
At breezy eve, along the irriguous plain
The fair Beckfordia leads her virgin train;
Seeks the cool grot, the ſhadowy rocks among,
And tunes the mountain-echoes to her ſong;
Or prints with graceful ſteps the margin green, 505
And brighter glories gild the enchanted ſcene.

---

having a greater proportional ſupply of nutriment, or poſſeſſing a greater facility of ſhooting their roots, or abſorbent veſſels, down the bark, will become leaf-buds, which might otherwiſe have been flower-buds, and the contrary; as explained in note on l. 479 of this Canto.

*Cloſed in the Style.* l. 485. "I conceive the medulla of a plant to conſiſt of a bundle of nervous fibres, and that the propelling vital power ſeparates their uppermoſt extremities. Theſe, diverging, penetrate the bark, which is now gelatinous, and become multiplied in the new gem, or leaf-bud. The aſcending veſſels of the bark being thus divided by the nervous fibres, which perforate it, and the aſcent of its fluids being thus impeded, the bark is extended into a leaf. But the flower is produced, when the protruſion of the medulla is greater than the retention of the including cortical part; whence the ſubſtance of the bark is expanded in the calyx; that of the rind (or interior bark), in the corol; that of the wood, in the ſtamens; that of the medulla, in the piſtil. Vegetation thus terminates in the production of new life, the ultimate medullary and cortical fibres being collected in the ſeeds." Linnæi Syſtema Veget. p. 6. edit. 14.

*Cintra.* l. 493. A village on the ſide of the rock of Liſbon: around the ſummit are abundance of cork trees, and ſome excavations, which a few monks inhabit, and ſleep on beds or benches of cork; near the village Mr. Beckford has an elegant ſeat.

2. "Where cruder juices ſwell the leafy vein,
Stint the young germ, the tender bloſſom ſtain;
On each lopp'd ſhoot a foſter ſcion bind,
Pith preſs'd to pith, and rind applied to rind;
So ſhall the trunk with loftier creſt aſcend,
And wide in air its happier arms extend;
Nurſe the new buds, admire the leaves unknown,
And bluſhing bend with fruitage not its own.

"Thus when in holy triumph Aaron trod,
And offer'd on the ſhrine his myſtic rod;
Firſt a new bark its ſilken tiſſue weaves,
New buds emerging widen into leaves;
Fair fruits protrude, enaſcent flowers expand,
And bluſh and tremble round the living wand.

XIII. 1. "*Sylphs!* on each Oak-bud wound the wormy galls
With pigmy ſpears, or cruſh the venom'd balls;
Fright the green Locuſt from his foamy bed,
Unweave the Caterpillar's gluey thread;
Chaſe the fierce Earwig, ſcare the bloated Toad,
Arreſt the Snail upon his ſlimy road;
Arm with ſharp thorns the Sweet-briar's tender wood,
And daſh the Cynips from her damaſk bud;

---

*Nurſe the new buds.* l. 513. Mr. Fairchild budded a paſſion-tree, whoſe leaves were ſpotted with yellow, into one which bears long fruit. The buds did not take; nevertheleſs, in a fortnight, yellow ſpots began to ſhew themſelves about three feet above the inoculation, and in a ſhort time afterwards yellow ſpots appeared on a ſhoot which came out of the ground from another part of the plant. Bradley, vol. II. p. 129. Theſe facts are the more curious, ſince, from experiments of ingrafting red currants on black, (ib. vol. II.) the fruit does not acquire any change of flavour, and, by many other experiments, neither colour, nor any other change, is produced in the fruit ingrafted on other ſtocks.

There is an apple deſcribed in Bradley's work, which is ſaid to have one ſide of it a ſweet fruit, which boils ſoft, and the other ſide a ſour fruit, which boils hard, which Mr. Bradley, ſo long ago as the year 1721, ingeniouſly aſcribes to the farina of one of theſe apples impregnating the other, which would ſeem the more probable if we conſider that each diviſion of an apple is a ſeparate womb, and may, therefore, have a ſeparate impregnation, like puppies of different kinds in one litter. The ſame is ſaid to have occurred in oranges and lemons, and grapes of different colours.

Steep in ambroſial dews the Woodbine's bells,
And drive the Night-moth from her honey'd cells.
So where the Humming-bird in Chili's bowers
On murmuring pinions robs the pendent flowers;
Seeks, where fine pores their dulcet balm diſtil,
And ſucks the treaſure with proboſcis-bill;
Fair CYPREPEDIA, with ſucceſsful guile,
Knits her ſmooth brow, extinguiſhes her ſmile;
A Spider's bloated paunch and jointed arms
Hide her fine form, and maſk her bluſhing charms;
In ambuſh ſly the mimic warrior lies,
And on quick wing the panting plunderer flies.

2. "Shield the young Harveſt from devouring blight,
The Smut's dark poiſon, and the Mildew white;

---

*Their dulcet balm diſtil.* l 533. See additional notes, No. XXXIX.

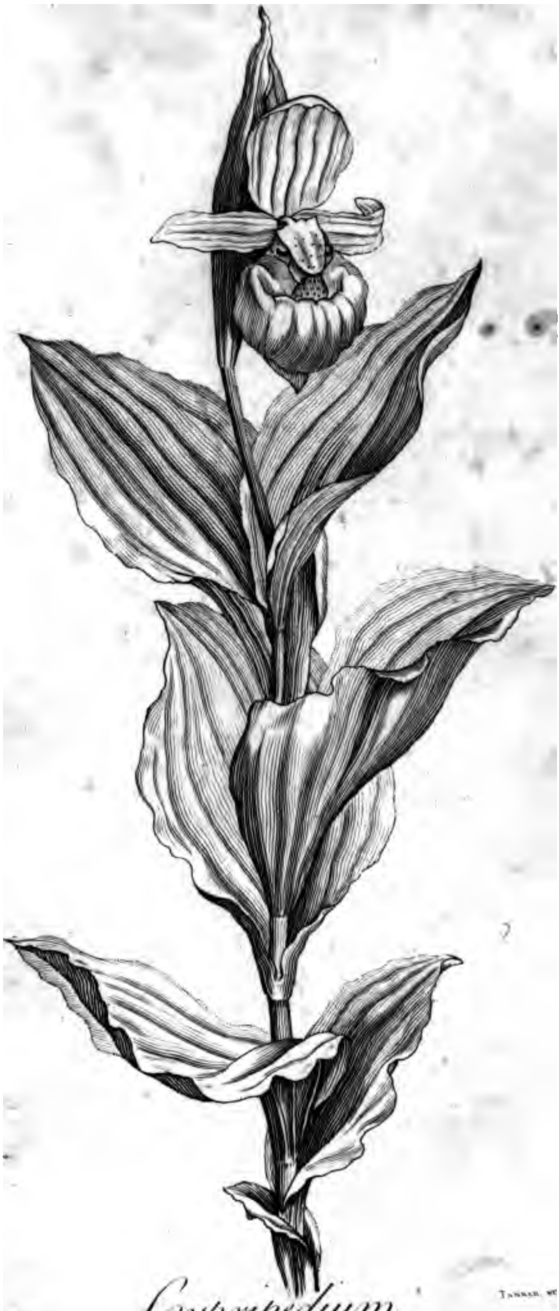
*Fair Cyprepedia.* l. 535. The cyprepedium from South-America is ſuppoſed to be of larger ſize, and brighter colours, than that from North-America, fro which this print is taken; it has a large globular nectary, about the ſize of a pigeon's egg, of a fleſhy colour, and an inciſion, or depreſſion, on its upper part, much reſembling the body of the large American ſpider: this globular nectary is attached to divergent ſlender petals, not unlike the legs of the ſame animal. This ſpider is called by Linnæus arenea avicularia, with a convex orbicular thorax, the centre tranſverſely excavated; he adds, that it catches ſmall birds as well as inſects, and has the venomous bite of a ſerpent. Syſtem. Natur. Tom. I. p. 1034. M. Lonvilliers de Poincy, (Hiſtoire Nat. des Antilles, Cap. xiv. art. III.) calls it phalange, and deſcribes the body to be the ſize of a pigeon's egg, with a hollow on its back like a navel and mentions its catching the humming-bird in its ſtrong nets.

The ſimilitude of this flower to this great ſpider, ſeems to be a vegetabl contrivance to prevent the humming-bird from plundering its honey. Abou Matlock, in Derbyſhire, the fly-ophris is produced, the nectary of whic ſo much reſembles the ſmall wall-bee, perhaps the apis ichneumonea, that i may be eaſily miſtaken for it at a ſmall diſtance. It is probable that b this means it may often eſcape being plundered. See note on lonicera, i the next poem.

A bird of our own country, called a willow-wren (motacilla) runs up t ſtem of the crown-imperial (frittillaria coronalis) and ſips the pendulo drops within its petals. This ſpecies of motacilla is called by Ray regul non criſtatus. White's Hiſt. of Selborne.

*Shield the young harveſt.* l. 541. Linnæus enumerates but four diſeaſe plants; Eryſyche, the white mucor, or mould, with ſeſſile tawny hea with which the leaves are ſprinkled, as is frequent on the hop, humulus, m ple, acer, &c. Rubigo, the ferrugineous powder ſprinkled under the leav frequent in lady's mantle, alchemilla, &c.

Clavus, when the ſeeds grow out into larger horns, black without, as rye. This is called Ergot by the French writers.



*Cypripedium*

TANNER, SCULP.

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ASTOR, LENOX AND
TILDEN FOUNDATIONS

Deep-rooted Mould, and Ergot's horn uncouth,
And break the Canker's deſolating tooth.
Firſt in one point the feſtering wound confined
Mines unperceived beneath the ſhrivel'd rind;
Then climbs the branches with increaſing ſtrength,
Spreads as they ſpread, and lengthens with their length.
—Thus the ſlight wound, ingraved on glaſs unneal'd,
Runs in white lines along the lucid field;
Crack follows crack, to laws elaſtic juſt,
And the frail fabric ſhivers into duſt.

Uſtulago, when the fruit, inſtead of ſeed, produces a black powder, as in barley, oats, &c. To which, perhaps, the honey-dew ought to have been added, and the canker; in the former of which the nouriſhing fluid of the plant ſeems to be exſuded by a retrograde motion of the cutaneous lymphatics, as in the ſweating ſickneſs of the laſt century. The latter is a phagedenic ulcer of the bark, very deſtructive to young apple-trees, and which, in cherry-trees, is attended with a depoſition of gum arabic, which often terminates in the death of the tree.

*Ergot's born.* l. 543. There is a diſeaſe frequently affects the rye in France, and ſometimes in England in moiſt ſeaſons, which is called Ergot, or horn-ſeed; the grain becomes conſiderably elongated, and is either ſtraight or crooked, containing black meal along with the white, and appears to be pierced by inſects, which were probably the cauſe of the diſeaſe. Mr. Du Hamel aſcribes it to this cauſe, and compares it to galls on oak-leaves. By the uſe of this bad grain amongſt the poor, diſeaſes have been produced, attended with great debility, and mortification of the extremities, both in France and England. Dict. Raiſon. art. Siegle. Phil. Tranſ.

*On glaſs unneal'd.* l. 549. The glaſs-makers occaſionally make what they call *proofs*, which are cooled haſtily, whereas the other glaſs veſſels are removed from warmer ovens to cooler ones, and ſuffered to cool by ſlow degrees, which is called annealing, or nealing them. If an unnealed glaſs be ſcratched by even a grain of ſand falling into it, it will ſeem to conſider of it for ſome time, or even a day, and will then crack into a thouſand pieces.

The ſame happens to a ſmooth ſurfaced lead-ore in Derbyſhire; the workmen, having cleared a large face of it, ſcratch it with picks, and, in a few hours, many tons of it crack to pieces, and fall, with a kind of exploſion. Whitehurſt's Theory of the Earth.

Glaſs dropped into cold water, called Prince Rupert's drops, explode, when a ſmall part of their tails are broken off, more ſuddenly indeed, but probably from the ſame cauſe. Are the internal particles of theſe elaſtic bodies kept ſo far from each other by the external cruſt, that they are nearly in a ſtate of repulſion, into which ſtate they are thrown by their vibrations from any violence applied? Or, like elaſtic balls in certain proportions ſuſpended in contact with each other, can motion, once begun, be increaſed by their elaſticity, till the whole explodes? And can this power be applied to any mechanical purpoſes?

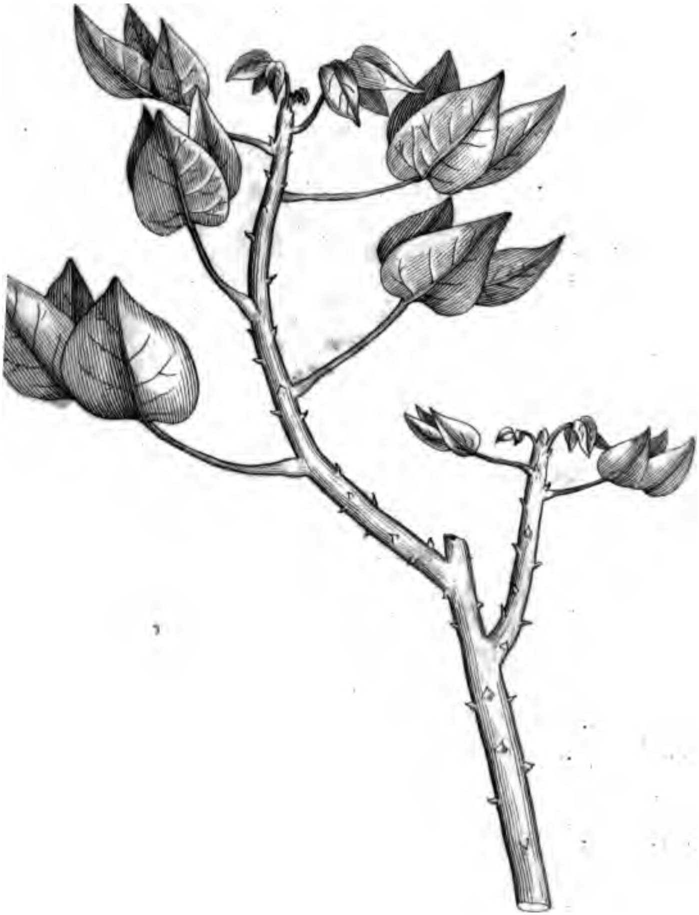
XIV. 1. " *Sylphs!* if with morn deſtructive Eurus ſprings,
O, claſp the Harebel with your velvet wings;
Screen with thick leaves the Jaſmine as it blows, 555
And ſhake the white rime from the ſhuddering Roſe;
Whilſt Amaryllis turns with graceful eaſe
Her bluſhing beauties, and eludes the breeze.—
*Sylphs!* if at noon the Fritillary droops,
With drops nectareous hang her nodding cups; 560
Thin clouds of goſſamer in air diſplay,
And hide the vale's chaſte Lily from the ray;
Whilſt Erythrina o'er her tender flower
Bends all her leaves, and braves the ſultry hour;—
Shield, when cold Heſper ſheds his dewy light, 565
Mimoſa's ſoft ſenſations from the night;
Fold her thin foliage, cloſe her timid flowers,
And with ambroſial ſlumbers guard her bowers;
O'er each warm wall while Cerea flings her arms,
And waſtes on night's dull eye a blaze of charms, 570

2. " Round her tall Elm with dewy fingers twine
The gadding tendrils of the adventurous Vine;
From arm to arm in gay feſtoons ſuſpend
Her fragrant flowers, her graceful foliage bend;
Swell with ſweet juice her vermil orbs, and feed 575
Shrined in tranſparent pulp her pearly ſeed;
Hang round the Orange all her ſilver bells,
And guard her fragrance with Heſperian ſpells;

---

*With ambroſial ſlumbers.* l. 568. Many vegetables, during the night, do not ſeem to reſpire, but to ſleep like the dormant animals and inſects in winter. This appears from the mimoſa and many other plants cloſing the upper ſides of their leaves together in their ſleep, and thus precluding that ſide of them from both light and air. And from many flowers cloſing up the poliſhed or interior ſide of their petals, which we have alſo endeavoured to ſhew to be a reſpiratory organ.

The irritability of plants is abundantly evinced by the abſorption and pulmonary circulation of their juices; their ſenſibility is ſhewn by the approaches of the males to the females, and of the females to the males, in numerous inſtances; and, as the eſſential circumſtance of ſleep conſiſts in the temporary abolition of voluntary power alone, the ſleep of plants evinces that they poſſeſs voluntary power; which alſo indiſputably appears in many of them, by cloſing their petals or their leaves during cold, or rain, or darkneſs, or from mechanic violence.



Tanner sc.

Erythrina Corallodendron.

ASTOR [illegible]
TILDEN [illegible] DATIONS

Bud after bud her poliſh'd leaves unfold,
And load her branches with ſucceſſive gold, 580
So the learn'd Alchemiſt exulting ſees
Riſe in his bright matraſs DIANA's trees;
Drop after drop, with juſt delay he pours
The red-fumed acid on Potoſi's ores;
With ſudden flaſh the fierce bullitions riſe, 585
And wide in air the gas phlogiſtic flies;
Slow ſhoot, at length, in many a brilliant maſs
Metallic roots acroſs the netted glaſs;
Branch after branch extend their ſilver ſtems,
Bud into gold, and bloſſom into gems. 590

" So ſits enthron'd in vegetable pride
Imperial KEW by Thames's glittering ſide;
Obedient ſails from realms unfurrow'd bring
For her the unnam'd progeny of ſpring;

---

*Diana's trees.* l. 582. The chemiſts and aſtronomers, from the earlieſt antiquity, have uſed the ſame characters to repreſent the metals and the planets, which were moſt probably outlines or abſtracts of the original hieroglyhic figures of Egypt. Theſe afterwards acquired niches in their temples, and repreſented Gods as well as metals and planets; whence ſilver is called Diana, or the moon, in the books of alchemy.

The proceſs for making Diana's ſilver tree is thus deſcribed by Lemeri. Diſſolve one ounce of pure ſilver in acid of nitre, very pure, and moderately ſtrong; mix this ſolution with about twenty ounces of diſtilled water; add to this two ounces of mercury, and let it remain at reſt. In about four days there will form upon the mercury a tree of ſilver, with branches imitating vegetation.

1. As the mercury has a greater affinity than ſilver with the nitrous acid, the ſilver becomes precipitated; and, being deprived of the nitrous oxygene by the mercury, ſinks down in its metallic form and luſtre. 2. The attraction between ſilver and mercury, which cauſes them readily to amalgamate together, occaſions the precipitated ſilver to adhere to the ſurface of the mercury in preference to any other part of the veſſel. 3. The attraction of the particles of the precipitated ſilver to each other, cauſes the beginning branches to thicken and elongate into trees and ſhrubs rooted on the mercury. For other circumſtances concerning this beautiful experiment, ſee Mr. Keir's Chemical Dictionary, art. Arbor Dianæ; a work, perhaps, of greater utility to mankind than the loſt Alexandrian Library, the continuation of which is ſo eagerly expected by all who are occupied in the arts, or attached to the ſciences.

Attendant Nymphs her dulcet mandates hear,
And nurſe in foſtering arms the tender year,
Plant the young bulb, inhume the living ſeed,
Prop the weak ſtem, the erring tendril lead;
Or fan in glaſs-built fanes the ſtranger flowers
With milder gales, and ſteep with warmer ſhowers.
Delighted Thames through tropic umbrage glides,
And flowers antarctic, bending o'er his tides;
Drinks the new tints, the ſweets unknown inhales,
And calls the ſons of ſcience to his vales.
In one bright point admiring Nature eyes
The fruits and foliage of diſcordant ſkies,
Twines the gay floret with the fragrant bough,
And bends the wreath round George's royal brow.
—Sometimes retiring from the public weal,
One tranquil hour the *Royal Partners* ſteal;
Through glades exotic paſs with ſtep ſublime,
Or mark the growths of Britain's happier clime;
With beauty bloſſom'd, and with virtue blaz'd,
Mark the fair Scions, that themſelves have rais'd;
Sweet blooms the Roſe, the towering Oak expands,
The Grace and Guard of Britain's golden lands.

XV. "*Sylphs!* who, round earth on purple pinions borne,
Attend the radiant chariot of the morn;
Lead the gay hours along the ethereal hight,
And on each dun meridian ſhower the light;
*Sylphs!* who from realms of equatorial day
To climes, that ſhudder in the polar ray,
From zone to zone purſue on ſhifting wing,
The bright perennial journey of the ſpring;
Bring my rich Balms from Mecca's hallow'd glades,
Sweet flowers, that glitter in Arabia's ſhades;
Fruits, whoſe fair forms in bright ſucceſſion glow,
Gilding the banks of Arno, or of Po;
Each leaf, whoſe fragrant ſteam with ruby lip
Gay China's nymphs from pictur'd vaſes ſip;

Each ſpicy rind, which ſultry India boaſts,
Scenting the night-air round her breezy coaſts;
Roots, whoſe bold ſtems in bleak Siberia blow,
And gem with many a tint the eternal ſnow;
Barks, whoſe broad umbrage high in ether waves
O'er Andes' ſteeps, and hides his golden caves;
—And, where yon oak extends his duſky ſhoots
Wide o'er the rill, that bubbles from his roots;
Beneath whoſe arms, protected from the ſtorm,
A turf-built altar rears its ruſtic form;
*Sylphs!* with religious hands freſh garlands twine,
And deck with laviſh pomp HYGEIA's ſhrine.

"Call with loud voice the Siſterhood, that dwell
On floating cloud, wide wave, or bubbling well;
Stamp with charm'd foot, convoke the alarmed Gnomes
From golden beds, and adamantine domes;
Each from her ſphere with beckoning arm invite,
Curl'd with red flame, the Veſtal Forms of light;
Cloſe all your ſpotted wings, in lucid ranks
Preſs with your bending knees the crouded banks,
Croſs your meek arms, incline your wreathed brows,
And win the Goddeſs with unwearied vows.

"Oh, wave, HYGEIA! o'er BRITANNIA's throne,
Thy ſerpent-wand, and mark it for thy own;
Lead round her breezy coaſts thy guardian trains,
Her nodding foreſts, and her waving plains;
Shed o'er her peopled realms thy beamy ſmile,
And with thy airy temple crown her iſle!"

The *Goddeſs* ceaſed,—and, calling from afar
The wandering Zephyrs, joins them to her car;
Mounts with light bound, and, graceful, as ſhe bends,
Whirls the long laſh, the flexile rein extends;
On whiſpering wheels the ſilver axle ſlides,
Climbs into air, and cleaves the cryſtal tides;

Burſt from its pearly chains, her amber hair
Streams o'er her ivory ſhoulders, buoy'd in air;
Swells her white veil, with ruby claſp confined
Round her fair brow, and undulates behind;
The leſſening courſers riſe in ſpiral rings,
Pierce the ſlow-ſailing clouds, and ſtretch their ſhadowy wings.

# THE
# BOTANIC GARDEN.

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# THE
# BOTANIC GARDEN.

## ADDITIONAL NOTES.

### NOTE I.--METEORS.

*Ethereal Powers! you chaſe the ſhooting ſtars,*
*Or yoke the vollied lightnings to your cars.* CANTO I. l. 115.

THERE ſeem to be three concentric ſtrata of our incumbent atmoſphere; in which, or between them, are produced four kinds of meteors; lightning, ſhooting ſtars, fire-balls, and northern lights. Firſt, the lower region of air, or that which is denſe enough to reſiſt, by the adheſion of its particles, the deſcent of condenſed vapour, or clouds, which may extend from one to three or four miles high. In this region the common lightning is produced from the accumulation or defect of electric matter in thoſe floating fields of vapour, either in reſpect to each other, or in reſpect to the earth beneath them, or the diſſolved vapour above them, which is conſtantly varying both with the change of the form of the clouds, which thus evolve a greater or leſs ſurface; and alſo with their ever-changing degree of condenſation. As the lightning is thus produced in denſe air, it proceeds but a ſhort courſe, on account of the greater reſiſtance which it encounters, is attended with a loud exploſion, and appears with a red light.

2. The ſecond region of the atmoſphere I ſuppoſe to be that which has too little tenacity to ſupport condenſed vapour, or clouds; but which yet contains inviſible vapour, or water in aerial ſolution. This aerial ſolution of water differs from that diſſolved in the matter of heat, as it is ſupported by its adheſion to the particles of air, and is not precipitated by cold. In this ſtratum it ſeems probable that the meteors called ſhooting ſtars are produced; and that they conſiſt of electric ſparks, or lightning, paſſing from one region to another of theſe inviſible fields of aero-aqueous ſolution. The height of theſe ſhooting ſtars has not yet been aſcertained by ſufficient obſervation. Dr. Blagden thinks their ſituation is lower down in the atmoſphere than that of fire-balls, which he conjectures from their ſwift apparent motion, and aſcribes their ſmallneſs to the more minute diviſion of the electric matter of which they are ſuppoſed to conſiſt, owing to the greater reſiſtance of the denſer medium through which they paſs, than that in which the fire-balls exiſt. Mr. Brydone obſerved that the ſhooting ſtars appeared

to him to be as high in the atmoſphere, when he was near the ſummit of Mount Etna, as they do when obſerved from the plain. Phil. Tranſ. vol. LXIII.

As the ſtratum of air in which ſhooting ſtars are ſuppoſed to exiſt, is much rarer than that in which lightning reſides, and yet much denſer than that in which fire-balls are produced, they will be attracted at a greater diſtance than the former, and at a leſs than the latter. From this rarity of the air, ſo ſmall a ſound will be produced by their exploſion, as not to reach the lower parts of the atmoſphere; their quantity of light, from their greater diſtance, being ſmall, is never ſeen through denſe air at all, and thence does not appear red, like lightning or fire-balls. There are no apparent clouds to emit or to attract them, becauſe the conſtituent parts of theſe aero-aqueous regions may poſſeſs an abundance or deficiency of electric matter, and yet be in perfect reciprocal ſolution. And, laſtly, their apparent train of light is probably owing only to a continuance of their impreſſion on the eye; as when a fire ſtick is whirled in the dark it gives the appearance of a complete circle of fire: for theſe white trains of ſhooting ſtars quickly vaniſh, and do not ſeem to ſet any thing on fire in their paſſage, as ſeems to happen in the tranſit of fire-balls.

3. The ſecond region or ſtratum of air terminates, I ſuppoſe, where the twilight ceaſes to be refracted, that is, where the air is 3000 times rarer than at the ſurface of the earth; and where it ſeems probable that the common air ends, and is ſurrounded by an atmoſphere of inflammable gas tenfold rarer than itſelf. In this region I believe fire-balls ſometimes to paſs, and at other times the northern lights to exiſt. One of theſe fire-balls, or draco volans, was obſerved by Dr. Pringle, and many others, on Nov. 26, 1758, which was afterwards eſtimated to have been a mile and a half in circumference, to have been about one hundred miles high, and to have moved towards the north with a velocity of near thirty miles in a ſecond of time. This meteor had a real tail many miles long, which threw off ſparks in its courſe, and the whole exploded, with a ſound like diſtant thunder. Phil. Tranſ. vol. LI.

Dr. Blagden has related the hiſtory of another large meteor, or fire-ball, which was ſeen the 18th of Auguſt, 1783, with many ingenious obſervations and conjectures. This was eſtimated to be between 60 and 70 miles high, and to travel 1000 miles at the rate of about twenty miles in a ſecond. This fire-ball had likewiſe a real train of light left behind it in its paſſage, which varied in colour, and, in ſome part of its courſe, gave off ſparks or exploſions where it had been brighteſt; and a duſky red ſtreak remained viſible perhaps a minute. Phil. Tranſ. vol. LXXIV.

Theſe fire-balls differ from lightning, and from ſhooting ſtars, in many remarkable circumſtances; as their very great bulk, being a mile and a half in diameter; their travelling 1000 miles nearly horizontally; their throwing off ſparks in their paſſage; and changing colours from bright blue to duſky red; and leaving a train of fire behind them, continuing about a minute. They differ from the northern lights in not being diffuſed, but paſſing from one point of the heavens to another in a defined line; and this in a region above the crepuſcular atmoſphere, where the air is 3000 times rarer than at the ſurface of the earth. There has not yet been even a conjecture which can account for theſe appearances!—One I ſhall therefore hazard; which, if it does not inform, may amuſe the reader.

In the note on l. 123, it was ſhewn that there is probably a ſupernatant ſtratum of inflammable gas or hydrogene, over the common atmoſphere; and whoſe denſity at the ſurface where they meet, muſt be at leaſt ten times leſs than that upon which it ſwims; like chemical ether floating upon water, and perhaps without any real contact. 1. In this region, where the aerial atmoſphere terminates, and the inflammable one begins, the quantity of tenacity or reſiſtance muſt be almoſt inconceivable; in which a ball of electricity might paſs 1000 miles with greater eaſe than through a thouſandth part of an inch of glaſs. 2. Such a ball of electricity paſſing between inflammable and common air, would ſet fire to them in a line as it paſſed along; which would differ in colour according to the greater proportionate commixture of the two airs; and from the ſame cauſe there might occur greater degrees of inflammation, or branches of fire, in ſome parts of its courſe.

As theſe fire-balls travel in a defined line, it is pretty evident from the known laws of electricity, that they muſt be attracted; and as they are a mile or more in diameter, they muſt be emitted from a large ſurface of electric matter; becauſe large nobs give larger ſparks, leſs diffuſed, and more brightly luminous, than leſs ones or points, and reſiſt more forcibly the emiſſion of the electric matter. What is there in nature can attract them at ſo great a diſtance as 1000 miles, and ſo forceibly as to detach an electric ſpark of a mile diameter? Can volcanos, at the time of their eruptions, have this effect, as they are generally attended with lightning? Future obſervations muſt diſcover theſe ſecret operations of nature! As a ſtream of common air is carried along with the paſſage of electric aura from one body to another, it is eaſy to conceive, that the common air and the inflammable air between which the fire-ball is ſuppoſed to paſs, will be partially intermixed by being thus agitated, and ſo far as it becomes intermixed it will take fire, and produce the linear flame and branching ſparks above deſcribed. In this circumſtance of their being attracted, and thence paſſing in a defined line, the fire-balls ſeem to differ from the coruſcations of the aurora borealis, or northern lights, which probably take place in the ſame region of the atmoſphere; where the common air exiſts in extreme tenuity, and is covered by a ſtill rarer ſphere of inflammable gas, ten times lighter than itſelf.

As the electric ſtreams, which conſtitute theſe northern lights, ſeem to be repelled or radiated from an accumulation of that fluid in the north, and not attracted like the fire-balls; this accounts for the diffuſion of their light, as well as the ſilence of their paſſage; while their variety of colours, and the permanency of them, and even the breadth of them in different places, may depend on their ſitting on fire the mixture of inflammable and common air through which they paſs; as ſeems to happen in the tranſit of the fire-balls.

It was obſerved by Dr. Prieſtley, that the electric ſhock taken through inflammable air was red, in common air it is bluiſh; to theſe circumſtances perhaps ſome of the colours of the northern lights may bear analogy; though the denſity of the medium through which light is ſeen muſt principally vary its colour, as is well explained by Mr. Morgan. Phil. Tranſ. Vol. LXXV. Hence lightning is red when ſeen through a dark cloud, or near the horizon; becauſe the more refrangible rays cannot permeate ſo denſe a medium. But the ſhooting ſtars conſiſt of white light, as they are generally ſeen on clear nights, and nearly verticial; in other ſituations their light is probably too faint to come to us. But as in ſome remarkable appearances of the northern lights, as in March, 1716, all the priſmatic colours were ſeen quickly to ſucceed each other, theſe appear to have been owing to real combuſtion; as the denſity of the interpoſed medium could not be ſuppoſed to change ſo frequently; and therefore theſe colours muſt have been owing to different degrees of heat, according to Mr. Morgan's theory of combuſtion. In Smith's Optics, p. 69. the priſmatic colours, and optical deceptions of the northern lights, are deſcribed by Mr. Cotes.

The Torricellian vacuum, if perfectly free from air, is ſaid, by Mr. Morgan and others, to be a perfect non-conductor. This circumſtance therefore would preclude the electric ſtreams from riſing above the atmoſphere. But as Mr. Morgan did not try to paſs an electric ſhock through a vacuum, and as air, or ſomething containing air, ſurrounding the tranſit of electricity, may be neceſſary to the production of light, the concluſion may perhaps ſtill be dubious. If, however, the ſtreams of the northern lights were ſuppoſed to riſe above our atmoſphere, they would only be viſible at each extremity of their courſe; where they emerge from, or are again immerged into the atmoſphere; but not in their journey through the vacuum; for the abſence of electric light in a vacuum is ſufficiently proved by the common experiment of ſhaking a barometer in the dark; the electricity, produced by the friction of the mercury in the glaſs at its top, is luminous if the barometer has a little air in it; but there is no light if the vacuum be complete.

The aurora borealis, or northern dawn, is very ingeniouſly accounted for by Dr. Franklin, on principles of electricity. He premiſes the following electric phenomena: 1. That all new-fallen ſnow has much poſitive electricity ſtanding on its ſurface. 2. That about twelve degrees of latitude round the poles are covered with a cruſt of eternal ice, which is impervious to the electric fluid. 3. That the denſe part of the atmoſphere riſes but a few miles high; and that in the rarer parts of it the electric fluid will paſs to almoſt any diſtance.

Hence he ſuppoſes there muſt be a great accumulation of poſitive electric matter on the freſh-fallen ſnow in the polar regions; which, not being able to paſs through the cruſt of ice into the earth, muſt riſe into the rare air of the upper parts of our atmoſphere, which will the leaſt reſiſt its paſſage; and paſſing towards the equator, deſcend again into the denſer atmoſphere, and thence into the earth in ſilent ſtreams. And that many of the appearances attending theſe lights are optical deceptions, owing to the ſituation of the eye that beholds them; which makes all aſcending parallel lines appear to converge to a point.

The idea, above explained in note on l. 123, of the exiſtence of a ſphere of inflammable gas over the aerial atmoſphere, would much favour this theory of Dr. Franklin; becauſe in that caſe the denſe aerial atmoſphere would riſe a much leſs height in the polar regions, diminiſhing almoſt to nothing at the pole itſelf; and thus give an eaſier paſſage to the aſcent of the electric fluid. And from the great difference in the ſpecific gravity of the two airs, and the velocity of the earth's rotation, there muſt be a place between the poles and the equator, where the ſuperior atmoſphere of inflammable gas would terminate; which would account for theſe ſtreams of the aurora borealis not appearing near the equator; add to this, that it is probable the electric fluid may be heavier than the magnetic one; and will thence, by the rotation of the earth's ſurface, aſcend over the magnetic one by its centrifugal force; and may thus be induced to riſe through the thin ſtratum of aerial atmoſphere over the poles. See note on Canto II. l. 193. I ſhall have occaſion again to mention this great accumulation of inflammable air over the poles; and to conjecture that theſe northern lights may be produced by the union of inflammable with common air, without the aſſiſtance of the electric ſpark to throw them into combuſtion.

The antiquity of the appearance of northern lights has been doubted; as none were recorded in our annals ſince the remarkable one on Nov. 14, 1574, till another remarkable one on March 6, 1716, and the three following nights, which was ſeen at the ſame time in Ireland, Ruſſia, and Poland, extending near 30 degrees of longitude, and from about the 50th degree of latitude over almoſt all the north of Europe. There is, however, reaſon to believe them of remote antiquity, though inaccurately deſcribed; thus the following curious paſſage from the book of Maccabees (B. II. c. v.) is ſuch a deſcription of them, as might probably be given by an ignorant and alarmed people. "Through all the city, for the ſpace of almoſt forty days, there were ſeen horſemen running in the air, in cloth of gold, and armed with lances, like a band of ſoldiers; and troops of horſemen in array encountering and running one againſt another, with ſhaking of ſhields and multitude of pikes, and drawing of ſwords, and caſting of darts, and glittering of golden ornaments and harneſs."

## NOTE II.—PRIMARY COLOURS.

*Cling round the aërial bow with priſms bright,*
*And pleaſed untwiſt the ſevenfold threads of light.* CANTO I. l. 117.

THE manner in which the rainbow is produced, was, in ſome meaſure, underſtood before Sir Iſaac Newton had diſcovered his theory of colours. The firſt perſon who expreſsly ſhewed the rainbow to be formed by the reflection of the ſun-beams from drops of falling rain, was Antonio de Dominis. This was afterwards more fully and diſtinctly explained by Des Cartes. But what cauſed the diverſity of its colours was not then underſtood; it was reſerved for the immortal Newton to diſcover that the rays of light conſiſted of ſeven combined colours of different refrangibility, which could be ſeparated at pleaſure by a wedge of glaſs. Pemberton's View of Newton.

Sir Iſaac Newton diſcovered that the priſmatic ſpectrum was compoſed of ſeven colours, in the following proportions; violet 80, indigo 40, blue 60, green 60, yellow 48, orange 27, red 45. If all theſe colours be painted on a circular card, in the proportion above mentioned, and the card be rapidly whirled on its centre, they produce in the eye the ſenſation of white. And any one of theſe colours may be imitated by painting a card with the two colours which are contiguous to it, in the ſame proportions as in the ſpectrum, and whirling them in the ſame manner.

My ingenious friend, Mr. Galton, of Birmingham, aſcertained, in this manner, by a ſet of experiments, the following propoſitions; the truth of which he had preconceived from the above data.

1. Any colour in the priſmatic ſpectrum may be imitated by a mixture of the two colours contiguous to it.

2. If any three ſucceſſive colours in the priſmatic ſpectrum are mixed, they compoſe only the ſecond or middlemoſt colour.

3. If any four ſucceſſive colours in the priſmatic ſpectrum be mixed, a tint ſimilar to a mixture of the ſecond and third colours will be produced, but not preciſely the ſame, becauſe they are not in the ſame proportion.

4. If, beginning with any colour in the circular ſpectrum, you take of the ſecond colour a quantity equal to the firſt, ſecond, and third; and add to that the fifth colour, equal in quantity to the fourth, fifth, and ſixth; and with theſe combine the ſeventh colour in the proportion it exiſts in the ſpectrum, white will be produced. Becauſe the firſt, ſecond, and third, compoſe only the ſecond; and the fourth, fifth, and ſixth, compoſe only the fifth; therefore, if the ſeventh be added, the ſame effect is produced as if all the ſeven were employed.

5. Beginning with any colour in the circular ſpectrum, if you take a tint compoſed of a certain proportion of the ſecond and third, (equal in quantity to the firſt, ſecond, third, and fourth,) and add to this the ſixth colour, equal in quantity to the fifth, ſixth, and ſeventh, white will be produced.

From theſe curious experiments of Mr. Galton, many phenomena in the chemical changes of colours may probably become better underſtood; eſpecially if, as I ſuppoſe, the ſame theory muſt apply to tranſmitted colours, as to reflected ones. Thus it is well known, that if the glaſs of manganeſe, which is a tint probably compoſed of violet and indigo, be mixed in a certain proportion with the glaſs of lead, which is yellow, that the mixture becomes tranſparent. Now, from Mr. Galton's experiments, it appears, that in reflected colours ſuch a mixture would produce white, that is, the ſame as if all the colours were reflected. And, therefore, in tranſmitted colours the ſame circumſtances muſt produce tranſparency, that is, the ſame as if all the colours were tranſmitted. For the particles which conſtitute the glaſs of manganeſe will tranſmit red, violet, indigo, and blue; and thoſe of the glaſs of lead will tranſmit orange, yellow, and green; hence all the primary colours, by a mixture of theſe glaſſes, become tranſmitted, that is, the glaſs becomes tranſparent.

Mr. Galton has further obſerved, that five ſucceſſive priſmatic colours may be combined in ſuch proportions as to produce but one colour, a circumſtance which might be of conſequence in the art of painting. For if you begin at any part of the circular ſpectrum above deſcribed, and take the firſt, ſecond, and third colours, in the proportions in which they exiſt in the ſpectrum; theſe will compoſe only the ſecond colour, equal in quantity to the firſt, ſecond, and third; add to theſe the third, fourth and fifth, in the proportion they exiſt in the ſpectrum, and theſe will produce the fourth colour, equal in quantity to the third, fourth, and fifth. Conſequently this is preciſely the ſame thing as mixing the ſecond and fourth colours only; which mixture would only produce the third colour. Therefore, if you combine the firſt, ſecond, fourth and fifth, in the proportions in which they exiſt in the ſpectrum, with double the quantity of the third colour, this third colour will be produced. It is probable that many of the unexpected changes in mixing colours on a painter's pallet, as well as in more fluid chemical mixtures, may depend on theſe principles rather than on a new arrangement or combination of their minute particles.

Mr. Galton further obſerves, that white may univerſally be produced by the combination of one priſmatic colour, and a tint intermediate to two others. Which tint may be diſtinguiſhed by a name compounded of the two colours to which it is intermediate. Thus white is produced by a mixture of red with blue-green. Of orange with indigo-blue. Of yellow with violet-indigo. Of green with red-violet. Of blue with orange-red. Of indigo with yellow-orange. Of violet with green-yellow. Which, he further remarks, exactly coincides with the theory and facts mentioned by Dr. Robert Darwin, of Shrewſbury, in his account of ocular ſpectra; who has ſhewn, that when one of theſe contraſted colours has been long viewed, a ſpectrum, or appearance of the other, becomes viſible in the fatigued eye. Phil. Tranſ. vol. LXXVI. for the year 1786.

Theſe experiments of Mr. Galton might much aſſiſt the copper-plate printers of callicoes and papers in colours, as three colours, or more, might be produced by two copper-plates. Thus, ſuppoſe ſome yellow figures were put on by the firſt plate, and upon ſome parts of theſe yellow figures, and on other parts of the ground, blue was laid on by another copper-plate. The three colours of yellow, blue, and green, might be produced, as green leaves with yellow and blue flowers.

## NOTE III.—COLOURED CLOUDS.

*Eve's ſilken couch with gorgeous tints adorn,*
*And fire the arrowy throne of riſing morn.* CANTO I. l. 119.

THE rays from the riſing and ſetting ſun are refracted by our ſpherical atmoſphere; hence the moſt refrangible rays, as the violet, indigo, and blue, are reflected in greater quantities from the morning and evening ſkies; and the leaſt refrangible ones, as red and orange, are laſt ſeen about the ſetting ſun. Hence Mr. Beguelin obſerved, that the ſhadow of his finger on his pocket-book was much bluer in the morning and evening, when the ſhadow was about eight times as long as the body from which it was projected. Mr. Melville obſerves, that the blue rays being more refrangible, are bent down in the evenings by our atmoſphere, while the red and orange, being leſs refrangible, continue to paſs on, and tinge the morning and evening clouds with their colours. See Prieſtley's Hiſtory of Light and Colours, p. 440. But as the particles of air, like thoſe of water, are themſelves blue, a blue ſhadow may be ſeen at all times of the day, though much more beautifully in the mornings and evenings, or by means of a candle in the middle of the day. For if a ſhadow on a piece of white paper is produced by placing your finger between the paper and a candle in the day light, the ſhadow will appear very blue; the yellow light of the candle upon the other parts of the paper apparently deepens the blue by its contraſt, theſe colours being oppoſite to each other, as explained in note II.

Colours are produced from clouds or miſts by refraction, as well as by reflection. In riding in the night over an unequal country, I obſerved a very beautiful coloured halo round the moon, whenever I was covered with a few feet of miſt, as I aſcended from the vallies, which ceaſed to appear when I roſe above the miſt. This I ſuppoſe was owing to the thinneſs of the ſtratum of miſt in which I was immerſed; had it been thicker, the colours refracted by the ſmall drops, of which a fog conſiſts, would not have paſſed through it down to my eye.

There is a bright ſpot ſeen on the cornea of the eye, when we face a window, which is much attended to by portrait-painters; this is the light reflected from the ſpherical ſurface of the poliſhed cornea, and brought to a focus; if the obſerver is placed in this focus, he ſees the image of the window; if he is placed before or behind the focus, he only ſees a luminous ſpot, which is more luminous, and of leſs extent, the nearer he approaches to the focus. The luminous appearance of the eyes of animals in the duſky corners of a room, or in holes in the earth, may ariſe, in ſome inſtances, from the ſame principle; viz. the reflection of the light from the ſpherical cornea, which will be coloured red or blue, in ſome degree, by the morning, evening, or meridian light, or by the objects from which that light is previouſly reflected. In the cavern at Colebrook Dale, where the mineral tar exſudes, the eyes of the horſe which was drawing a cart from within towards the mouth of it, appeared like two balls of phoſphorus, when he was above 100 yards off, and for a long time before any other part of the animal was viſible. In this caſe I ſuſpect the luminous appearance to have been owing to the light which had entered the eye, being reflected from the back ſurface of the vitreous humor, and thence emerging again in parallel rays from the animal's eye, as it does from the back ſurface of the drops of the rainbow, and from the water-drops which lie, perhaps without contact, on cabbage-leaves, and have the brilliancy of quick-ſilver. This accounts for this luminous appearance being beſt ſeen in thoſe animals which have large apertures in their iris, as in cats and horſes, and is the only part viſible in obſcure places, becauſe this is a better reflecting ſurface than any other part of the animal. If any of theſe emergent rays from the animal's eye can be ſuppoſed to have been reflected from the choroid coat, through the ſemi-tranſparent retina, this would account for the coloured glare of the eyes of dogs, or cats, and rabits, in dark corners.

## NOTE IV.—COMETS.

*Alarm with comet-blaze the ſapphire plain,*
*The wan ſtars glimmering through its ſilver train.* CANTO I. l. 133.

THERE have been many theories invented to account for the tails of comets. Sir Iſaac Newton thinks that they conſiſt of rare vapours raiſed from the nucleus of the comet, and ſo rarefied by the ſun's heat as to have their general gravitation diminiſhed, and that they, in conſequence, aſcend oppoſite to the ſun, and from thence reflect the rays of light. Dr. Halley compares the light of the tails of comets to the ſtreams of the aurora borealis, and other electric effluvia. Phil. Tranſ. No. 347.

Dr. Hamilton obſerves, that the light of ſmall ſtars is ſeen undiminiſhed through both the light of the tails of comets, and of the aurora borealis, and has farther illuſtrated their electric analogy; and adds, that the tails of comets conſiſt of a lucid ſelf-ſhining ſubſtance, which has not the power of refracting or reflecting the rays of light. Eſſays.

The tail of the comet of 1744, at one time appeared to extend above 16 degrees from its body, and muſt have thence been above twenty-three millions of miles long. And the comet of 1680, according to the calculations of Dr. Halley, on Nov. the 11th, was not above one ſemi-diameter of the earth, or leſs than 4000 miles to the northward of the way of the earth; at which time had the earth been in that part of its orbit, what might have been the conſequence! No one would probably have ſurvived to have regiſtered the tremendous effects.

The comet of 1531, 1607, and 1682, having returned in the year 1759, according to Dr. Halley's prediction in the Phil. Tranſ. for 1705, there ſeems no reaſon to doubt that all the other comets will return after their proper periods. Aſtronomers have in general acquieſced in the conjecture of Dr. Halley, that the comets of 1532, and 1661, are one and the ſame comet, from the ſimilarity of the elements of their orbits, and were, therefore, induced to expect its return to its perihelium in 1789. As this comet is liable to be diſturbed, in its aſcent from the ſun, by the planets Jupiter and Saturn, Dr. Maſkelyne expected its return to its perihelium in the beginning of the year 1789, or the latter end of the year 1788, and certainly ſome time before the 27th of April, 1789; which prediction has not been fulfilled. Phil. Tranſ. vol. LXXVI.

As the comets are ſmall maſſes of matter, and paſs in their perihelion very near the ſun, and become inviſible to us, on theſe accounts, in a ſhort ſpace of time, their number has not yet been aſcertained, and will probably increaſe with the improvement of our teleſcopes. M. Bode has given a table of 72 comets, whoſe orbits are already calculated; of theſe 60 paſs within the earth's orbit, and only twelve without it; and moſt of them appear between the orbits of Venus and Mercury, or nearly midway between the ſun and earth; from whence, and from the planes of their orbits being inclined to that of the earth and other planets in all poſſible angles, they are believed to be leſs liable to interfere with, or injure each other. M. Bode afterwards inquires into the neareſt approach it is poſſible for each of the known comets to make towards the earth's orbit. He finds that only three of them can come within a diſtance equal to two or three times the diſtance of the moon from it; and then adds the great improbability, that the earth ſhould be in that dangerous point of its orbit, at the inſtant when a comet, which may have been abſent ſome centuries, paſſes ſo rapidly paſt it. Hiſtoire de l'Academ. Royal. Berlin. 1792.

## NOTE V.—SUN'S RAYS.

*Or give the ſun's phlogiſtic orb to roll.* CANTO I. l. 136.

THE diſpute among philoſophers about phlogiſton is not concerning the exiſtence of an inflammable principle, but rather whether there be one or more inflammable principles. The diſciples of Stahl, which till lately included the whole chemical world, believed in the identity of phlogiſton in all bodies which would flame or calcine. The diſciples of Lavoiſier pay homage to a plurality of phlogiſtons, under the various names of charcoal, ſulphur, metals, &c. Whatever will unite with *pure* air, and thence compoſe an acid, is eſteemed, in this ingenious theory, to be a different kind of phlogiſtic or inflammable body. At the ſame time there remains a doubt whether theſe inflammable bodies, as metals, ſulphur, charcoal, &c. may not be compounded of the ſame phlogiſton along with ſome other material yet undiſcovered, and thus an unity of phlogiſton exiſt, as in the theory of Stahl, though very differently applied in the explication of chemical phenomena.

Some modern philoſophers are of opinion, that the ſun is the great fountain from which the earth and other planets derive all the phlogiſton which they poſſeſs; and that this is formed by the combination of the ſolar rays with all opake bodies, but particularly with the leaves of vegetables, which they ſuppoſe to be organs adapted to abſorb them. And that as animals receive their nouriſhment from vegetables, they alſo obtain, in a ſecondary manner, their phlogiſton from the ſun. And laſtly, as great maſſes of the mineral kingdom, which have been found in the thin cruſt of the earth which human labour has penetrated, have evidently been formed from the recrements of animal and vegetable bodies, theſe alſo are ſuppoſed thus to have derived their phlogiſton from the ſun.

Another opinion concerning the ſun's rays is, that they are not luminous till they arrive at our atmoſphere; and that there uniting with ſome part of the air, they produce combuſtion, and light is emitted; and that an ethereal acid, yet undiſcovered, is formed from this combuſtion.

The more probable opinion is, perhaps, that the ſun is a phlogiſtic maſs of matter, whoſe ſurface is in a ſtate of combuſtion, which, like other burning bodies, emits light, with immenſe velocity, in all directions; that theſe rays of light act upon all opake bodies, and, combining with them, either diſplace or produce their elementary heat, and become chemically combined with the phlogiſtic part of them; for light is given out when phlogiſtic bodies unite with the oxygenous principle of the air, as in combuſtion, or in the reduction of metallic calxes; thus in preſenting to the flame of a candle a letter-wafer (if it be coloured with red-lead) at the time the red-lead becomes a metallic drop, a flaſh of light is perceived. Dr. Alexander Wilſon very ingeniouſly endeavours to prove, that the ſun is only in a ſtate of combuſtion on its ſurface, and that the dark ſpots ſeen on the diſk are excavations or caverns through the luminous cruſt, ſome of which are 4000 miles in diameter. Phil. Tranſ. 1774. Of this I ſhall have occaſion to ſpeak again.

## NOTE VI.—CENTRAL FIRES.

*Round her ſtill-centre tread the burning ſoil,*
*And watch the billowy Lavas as they boil.* CANTO I. l. 139.

M. DE MAIRAN, in a paper publiſhed in the Hiſtoire de l'Academie de Sciences, 1765, has endeavoured to ſhew, that the earth receives but a ſmall part of the heat which it poſſeſſes, from the ſun's rays, but it is principally heated by fires within itſelf. He thinks the ſun is the cauſe of the viciſſitudes of our ſeaſons of ſummer and winter, by a very ſmall quantity of heat in addition to that already reſiding in the earth, which, by emanations from the centre to the circumference, renders the ſurface habitable, and without which, though the ſun was conſtantly to illuminate two thirds of the globe at once, with a heat equal to that at the equator, it would ſoon become a maſs of ſolid ice. His reaſonings and calculations on this ſubject are too long and too intricate to be inſerted here, but are equally curious and ingenious, and carry much conviction along with them.

The opinion that the centre of the earth conſiſts of a large maſs of burning lava, has been eſpouſed by Boyle, Boerhaave, and many other philoſophers. Some of whom, conſidering its ſuppoſed effects on vegetation and the formation of minerals, have called it a ſecond ſun. There are many arguments in ſupport of this opinion. 1. Becauſe the power of the ſun does not extend much beyond ten feet deep into the earth, all below being, in winter and ſummer, always of the ſame degree of heat, viz. 48, which being much warmer than the mildeſt froſt, is ſuppoſed to be ſuſtained by ſome internal diſtant fire. Add to this, however, that from experiments made ſome years ago by Dr. Franklin, the ſpring-water at Philadelphia appeared to be of 52 of heat, which ſeems farther to confirm this opinion, ſince the climates in North-America are ſuppoſed to be colder than thoſe of Europe under ſimilar degrees of latitude. 2. M. De Luc, in going 1359 feet perpendicular into the mines of Hartz, on July the 5th, 1778, on a very fine day, found the air at the bottom a little warmer than at the top of the ſhaft. Phil. Tranſ. vol. LXIX. p. 488. In the mines in Hungary, which are 500 cubits deep, the heat becomes very troubleſome when the miners get below 480 feet depth. *Morinus de Locis ſubter.* p. 131. But as ſome other deep mines, as mentioned by Mr. Kirwan, are ſaid to poſſeſs but the common heat of the earth; and as the cruſt of the globe, thus penetrated by human labour, is ſo thin compared with the whole, no certain deduction can be made from theſe facts on either ſide of the queſtion. 3. The warm-ſprings in many parts of the earth, at great diſtance from any volcanos, ſeem to originate from the condenſation of vapours ariſing from water which is boiled by ſubterraneous fires, and cooled again in their paſſage through a certain length of the colder ſoil; for the theory of chemical ſolution will not explain the equality of their heat at all ſeaſons, and through ſo many centuries. See note on Fucus, in vol. II. See a letter on this ſubject in Mr. Pilkinton's View of Derbyſhire, from Dr. Darwin. 4. From the ſituations of volcanos which are always found upon the ſummit of the higheſt mountains. For as theſe mountains have been lifted up, and loſe ſeveral of their uppermoſt ſtrata as they riſe, the loweſt ſtrata of the earth yet known appear at the tops of the higheſt hills; and the beds of the volcanos upon theſe hills muſt, in conſequence, belong to the loweſt ſtrata of the earth, conſiſting, perhaps, of granite or baſaltes, which were produced before the exiſtence of animal or vegetable bodies, and might conſtitute the original nucleus of the earth, which I have ſuppoſed to have been projected from the ſun; hence the volcanos themſelves appear to be ſpiracula, or chimneys, belonging to great central fires. It is probably owing to the eſcape of the elaſtic vapours from theſe ſpiracula, that the modern earthquakes are of ſuch ſmall extent compared with thoſe of remote antiquity, of which the veſtiges remain all over the globe. 5. The great ſize and height of the continents, and the great ſize and depth of the South-ſea, Atlantic, and other oceans, evince that the firſt earthquakes, which produced theſe immenſe changes in the globe, muſt have been occaſioned by central fires. 6. The very diſtant and expeditious communication of the ſhocks of ſome great earthquakes. The earthquake at Liſbon, in 1755, was perceived in Scotland, in the Peak of Derbyſhire, and in many other diſtant parts of Europe. The percuſſions of it travelled with about the velocity of ſound, viz. about thirteen miles in a minute. The earthquake in 1693 extended 2600 leagues. (Goldſmith's Hiſtory.) Theſe phenomena are eaſily explained if the central parts of the earth conſiſt of a fluid lava, as a percuſſion on one part of ſuch a fluid maſs would be felt on other parts of its confining vault, like a ſtroke on a fluid contained in a bladder, which, however gentle on one ſide, is perceptible to the hand placed on the other; and the velocity with which ſuch a concuſſion would travel, would be that of ſound, or thirteen miles in a minute. For further information on this part of the ſubject, the reader is referred to Mr. Michel's excellent treatiſe on earthquakes in the Phil. Tranſ. vol. LI. 7. That there is a cavity at the centre of the earth is made probable by the late experiments on the attraction of mountains, by Mr. Maſkelyne, who ſuppoſed, from other conſiderations, that the denſity of the earth near the ſurface ſhould be five times leſs than its mean denſity. Phil. Tranſ. vol. LXV. p. 498. But found from the attraction of the mountain Schehallien, that it is probable, the mean denſity of the earth is but double that of the hill. Ibid. p. 532. Hence, if the firſt ſuppoſition be well founded, there would appear to be a cavity at the centre of conſiderable magnitude, from whence the immenſe beds and mountains of lava, toadſtone, baſaltes, granite, &c. have been protruded. 8. The variation of the compaſs can only be accounted for by ſuppoſing the central parts of the earth to conſiſt of a fluid maſs, and that part of this fluid is iron, which, requiring a greater degree of heat to bring it into fuſion than glaſs or other metals, remains a ſolid, and the vis inertæ of this fluid maſs, with the iron in it, occaſions it to perform fewer revolutions than the cruſt of ſolid earth over it, and thus it is gradually left behind, and the place where the floating iron reſides is pointed to by the direct or retrograde motions of the magnetic needle. This ſeems to have been nearly the opinion of Dr. Halley and Mr. Euler.

## NOTE VII.—ELEMENTARY HEAT.

*Or ſphere on ſphere in widening waves expand,*
*And glad with genial warmth the incumbent land.* CANTO I. l. 143.

A CERTAIN quantity of heat ſeems to be combined with all bodies, beſides the ſenſible quantity which gravitates like the electric fluid amongſt them. This combined heat, or latent heat, of Dr. Black, when ſet at liberty by fermentation, inflammation, cryſtallization, freezing, or other chemical attractions producing new *combination*, paſſes as a fluid element into the ſurrounding bodies. And by thawing, diffuſion of neutral ſalts in water, melting, and other chemical *ſolutions*, a portion of heat is attracted from the bodies in vicinity, and enters into or becomes combined with the new ſolutions.

Hence a *combination* of metals with acids, of eſſential oils and acids, of alcohol and water, of acids and water, give out heat; whilſt a *ſolution* of ſnow in water or in acids, and of neutral ſalts in water, attract heat from the ſurrounding bodies. So the acid of nitre mixed with oil of cloves unites with it, and produces a moſt violent flame; the ſame acid of nitre poured on ſnow inſtantly diſſolves it, and produces the greateſt degree of cold yet known, by which, at Peterſburgh, quick-ſilver was firſt frozen in 1760.

Water may be cooled below 32 degrees without being frozen, if it be placed on a ſolid floor, and ſecured from agitation; but when thus cooled below the freezing point, the leaſt agitation turns part of it ſuddenly into ice, and when this ſudden freezing takes place, a thermometer placed in it inſtantly riſes, as ſome heat is given out in the act of congelation, and the ice is thus left with the ſame *ſenſible* degree of cold as the water had poſſeſſed before it was agitated, but is, nevertheleſs, now combined with leſs *latent* heat.

A cubic inch of water thus cooled down to 32 degrees, mixed with an equal quantity of boiling water at 212 degrees, will cool it to the middle number between theſe two, or to 122. But a cubic inch of ice, whoſe ſenſible cold alſo is but 32, mixed with an equal quantity of boiling water, will cool it ſix times as much as the cubic inch of cold water above-mentioned, as the ice not only gains its ſhare of the ſenſible or gravitating heat of the boiling water, but attracts to itſelf alſo, and combines with the quantity of latent heat which it had loſt at the time of its congelation.

So boiling water will acquire but 212 degrees of heat under the common preſſure of the atmoſphere, but the ſteam raiſed from it by its expanſion, or by its ſolution in the atmoſphere, combines with and carries away a prodigious quantity of heat, which it again parts with on its condenſation, as is ſeen in common diſtillation, where the large quantity of water in the worm tub is ſo ſoon heated. Hence the evaporation of ether on a thermometer ſoon ſinks the mercury below freezing, and hence a warmth of the air in winter frequently ſucceeds a ſhower.

When the matter of heat, or calorique, is ſet at liberty from its combinations, as by inflammation, it paſſes into the ſurrounding bodies, which poſſeſs different capacities of acquiring their ſhare of the looſe or ſenſible heat; thus a pint meaſure of cold water at 48 degrees, mixed with a pint of boiling water at 212 degrees, will cool it to the degree between theſe two numbers, or to 154 degrees, but it requires two pint meaſures of quick-ſilver at 48 degrees of heat, to cool one pint of water as above. Theſe and other curious experiments are adduced by Dr. Black, to evince the exiſtence of combined or latent heat in bodies, as has been explained by ſome of his pupils, and well illuſtrated by Dr. Crawford. The world has long been in expectation of an account of his diſcoveries on this ſubject by the celebrated author himſelf.

As this doctrine of elementary heat in its fluid and combined ſtate is not yet univerſally received, I ſhall here add two arguments in ſupport of it, drawn from different ſources, viz. from the heat given out or abſorbed by the mechanical condenſation or expanſion of the air, and perhaps of other bodies, and from the analogy of the various phenomena of heat with thoſe of electricity.

I. If a thermometer be placed in the receiver of an air-pump, and the air haſtily exhauſted, the thermometer will ſink ſome degrees, and the glaſs become ſteamy; the ſame occurs in haſtily admitting a part of the air again. This I ſuppoſe to be produced by the expanſion of part of the air, both during the exhauſtion and re-admiſſion of it; and that the air ſo expanded becomes capable of attracting from the bodies in its vicinity a part of their heat, hence the vapours contained in it, and the glaſs receiver, are for a time colder, and the ſteam is precipitated. That the air thus parts with its moiſture from the cold occaſioned by its rarefaction, and not ſimply by the rarefaction itſelf, is evident, becauſe, in a minute or two, the ſame rarefied air will again take up the dew depoſited on the receiver; and becauſe water will evaporate ſooner in rare than in denſe air.

There is a curious phenomenon, ſimilar to this, obſerved in the fountain of Hiero, conſtructed on a large ſcale at the Chemnicenſian mines in Hungary. In this machine, the air in a large veſſel is compreſſed by a column of water 260 feet high, a ſtop-cock is then opened, and as the air iſſues out with great vehemence, and thus becomes immediately greatly expanded, ſo much cold is produced, that the moiſture from this ſtream of air is precipitated in the form of ſnow, and ice is formed, adhering to the noſel of the cock. This remarkable circumſtance is deſcribed at large, with a plate of the machine, in Phil. Tranſ. vol. LII. for 1761.

The following experiment is related by Dr. Darwin, in the Phil. Tranſ. vol. LXXVIII. Having charged an air-gun as forcibly as he well could, the air-cell and ſyringe became exceedingly hot, much more ſo than could be aſcribed to the friction in working it; it was then left about half an hour to cool down the temperature of the air, and a thermometer having been previouſly fixed againſt a wall, the air was diſcharged in a continual ſtream on its bulb, and it ſunk many degrees. From theſe three experiments of the ſteam in the exhauſted receiver being depoſited and re-abſorbed, when a part of the air is exhauſted or re-admitted, and the ſnow produced by the fountain of Hiero, and the extraordinary heat given out in charging, and the cold produced in diſcharging an air-gun, there is reaſon to conclude, that when air is mechanically compreſſed, the elementary fluid heat is preſſed out of it, and that when it is mechanically expanded the ſame fluid heat is re-abſorbed from the common maſs.

It is probable all other bodies as well as air attract heat from their neighbours when they are mechanically expanded, and give it out when they are mechanically condenſed. Thus when a vibration of the particles of hard bodies is excited by friction or by percuſſion, theſe particles mutually recede from and approach each other reciprocally; at the times of their receſſion from each other, the body becomes enlarged in bulk, and is then in a condition to attract heat from thoſe in its vicinity with great and ſudden power, at the times of their approach to each other this heat is again given out; but the bodies in contact having in the mean while received the heat they had thus loſt, from other bodies behind them, do not ſo ſuddenly or ſo forcibly re-abſorb the heat again from the body in vibration; hence it remains on its ſurface like the electric fluid on a rubbed glaſs globe, and for the ſame reaſon, becauſe there is no good conductor to take it up again. Hence at every vibration more and more heat is acquired, and ſtands looſe upon the ſurface, as in filing metals, or rubbing glaſs tubes, and thus a ſmith, with a few ſtrokes on a nail on his anvil, can make it hot enough to light a brimſtone match; and hence in ſtriking flint and ſteel together, heat enough is produced to vitrify the parts thus ſtrucken off, the quantity of which heat is again probably increaſed by the new chemical combination.

II. The analogy between the phenomena of the electric fluid and of heat, furniſhes another argument in ſupport of the exiſtence of heat as a gravitating fluid. 1. They are both accumulated by friction on the excited body. 2. They are propagated eaſily or with difficulty along the ſame claſſes of bodies; with eaſe by metals, with leſs eaſe by water, and with difficulty by reſins, bees-wax, ſilk, air, and glaſs. Thus glaſs canes, or canes of ſealing-wax, may be melted by a blow-pipe, or a candle, within a quarter of an inch of the fingers which hold them, without any inconvenient heat, while a pin, or other metallic ſubſtance, applied to the flame of a candle, ſo readily conducts the heat as immediately to burn the fingers. Hence clothes of ſilk keep the body warmer than clothes of linen of equal thickneſs, by confining the heat upon the body. And hence plains are ſo much warmer than the ſummits of mountains, by the greater denſity of the air confining the acquired heat upon them. 3. They both give out light in their paſſage through air, perhaps not in their paſſage through a vacuum. 4. They both of them fuſe or vitrify metals. 5. Bodies, after being electrized, if they are mechanically extended, will receive a greater quantity of electricity, as in Dr. Franklin's experiment of the chain in the tankard; the ſame ſeems true in reſpect to heat, as explained above. 6. Both heat and electricity contribute to ſuſpend ſteam in the atmoſphere, by producing or increaſing the repulſion of its particles. 7. They both gravitate, when they have been accumulated, till they find their equilibrium.

If we add to the above the many chemical experiments which receive an eaſy and elegant explanation from the ſuppoſed matter of heat, as employed in the works of Bergman and Lavoiſier, I think we may reaſonably allow of its exiſtence as an element, occaſionally combined with other bodies, and occaſionally exiſting as a fluid, like the electric fluid gravitating amongſt them, and that hence it may be propagated from the central fires of the earth to the whole maſs, and contribute to preſerve the mean heat of the earth, which, in this country, is about 48 degrees, but variable from the greater or leſs effect of the ſun's heat in different climates, ſo well explained in Mr. Kirwan's Treatiſe on the temperature of different latitudes. 1787. Elmſly. London.

## NOTE VIII.—MEMNON's LYRE.

*So to the ſacred Sun in Memnon's fane,*
*Spontaneous concords quired the matin ſtrain.* CANTO I. l. 183.

THE gigantic ſtatue of Memnon, in his temple at Thebes, had a lyre in his hands, which, many credible writers aſſure us, ſounded when the riſing ſun ſhone upon it. Some philoſophers have ſuppoſed that the ſun's light poſſeſſes a mechanical impulſe, and that the ſounds above-mentioned might be thence produced. Mr. Michel conſtructed a very tender horizontal balance, as related by Dr. Prieſtley in his hiſtory of light and colours, for this purpoſe, but ſome experiments, with this balance, which I ſaw made by the late Dr. Powel, who threw the focus of a large reflector on one extremity of it, were not concluſive either way, as the copper leaf of the balance approached in one experiment and receded in another.

There are, however, methods by which either a rotative or alternating motion may be produced by very moderate degrees of heat. If a ſtraight glaſs tube, ſuch as are uſed for barometers, be ſuſpended horizontally before a fire, like a roaſting ſpit, it will revolve by intervals; for as glaſs is a bad conductor of heat, the ſide next the fire becomes heated ſooner than the oppoſite ſide, and the tube becomes bent into a bow, with the external part of the curve towards the fire; this curve then falls down, and produces a fourth part of a revolution of the glaſs tube, which thus revolves with intermediate pauſes.

Another alternating motion I have ſeen produced by ſuſpending a glaſs tube about eight inches long, with bulbs at each end, on a centre like a ſcale-beam. This curious machine is filled about one third part with pureſt ſpirit of wine, the other two thirds being a vacuum, and is called a pulſe-glaſs: if it be placed on a box before the fire, ſo that either bulb, as it riſes, may become ſhaded from the fire, and expoſed to it when it deſcends, an alternate libration of it is produced. For ſpirit of wine in vacuo emits ſteam by a very ſmall degree of heat, and this ſteam forces the ſpirit beneath it up into the upper bulb, which therefore deſcends. It is probable ſuch a machine, on a larger ſcale, might be of uſe to open the doors or windows of hot-houſes or melon-frames, when the air within them ſhould become too much heated, or might be employed in more important mechanical purpoſes.

On travelling through a hot ſummer's day in a chaiſe, with a box covered with leather on the fore-axle-tree, I obſerved, as the ſun ſhone upon the black leather, the box began to open its lid, which, at noon, roſe above a foot, and could not, without great force, be preſſed down; and which gradually cloſed again as the ſun declined in the evening. This, I ſuppoſe, might with ſtill greater facility be applied to the purpoſe of opening melon-frames, or the ſaſhes of hot-houſes.

The ſtatue of Memnon was overthrown and ſawed in two by Cambyſes, to diſcover its internal ſtructure, and is ſaid ſtill to exiſt. See Savery's Letters on Egypt. The truncated ſtatue is ſaid, for many centuries, to have ſaluted the riſing ſun with cheerful tones, and the ſetting ſun with melancholy ones.

## NOTE IX.—LUMINOUS INSECTS.

*Star of the earth, and diamond of the night.* Canto I. l. 196.

THERE are eighteen ſpecies of Lampyris, or glow-worm, according to Linnæus, ſome of which are found in almoſt every part of the world. In many of the ſpecies the females have no wings, and are ſuppoſed to be diſcovered by the winged males by their ſhining in the night. They become much more lucid when they put themſelves in motion, which would ſeem to indicate that their light is owing to their reſpiration; in which proceſs it is probable phoſphoric acid is produced by the combination of vital air with ſome part of the blood, and that light is given out through their tranſparent bodies, by this ſlow internal combuſtion.

There is a fire-fly, of the beetle kind, deſcribed in the Dict. Raiſonné, under the name of Acudia, which is ſaid to be two inches long, and inhabits the Weſt-Indies and South-America; the natives uſe them inſtead of candles, putting from one to three of them under a glaſs. Madam Merian ſays, that at Surinam the light of this fly is ſo great, that ſhe ſaw ſufficiently well by one of them to paint and finiſh one of the figures of them in her work on inſects. The largeſt and oldeſt of them are ſaid to become four inches long, and to ſhine like a ſhooting ſtar as they fly, and are thence called Lantern-bearers. The uſe of this light to the inſect itſelf ſeems to be, that it may not fly againſt objects in the night; by which contrivance theſe inſects are enabled to procure their ſuſtenance either by night or day, as their wants may require, or their numerous enemies permit them; whereas ſome of our beetles have eyes adapted only to the night, and if they happen to come abroad too ſoon in the evening, are ſo dazzled that they fly againſt every thing in their way. See note on Phoſphorus, No. X.

In ſome ſeas, as particularly about the coaſt of Malabar, as a ſhip floats along, it ſeems, during the night, to be ſurrounded with fire, and to leave a long tract of light behind it. Whenever the ſea is gently agitated, it ſeems converted into little ſtars; every drop, as it breaks, emits light, like bodies electrified in the dark. Mr. Bomare ſays, that when he was at the port of Cettes, in Languedoc, and bathing with a companion in the ſea, after a very hot day, they both appeared covered with fire after every immerſion, and that laying his wet hand on the arm of his companion, who had not then dipped himſelf, the exact mark of his hand and fingers was ſeen in characters of fire. As numerous microſcopic inſects are found in this ſhining water, its light has been generally aſcribed to them, though it ſeems probable that fiſh-ſlime, in hot countries, may become in ſuch a ſtate of incipient putrefaction, as to give light, eſpecially when by agitation it is more expoſed to the air; otherwiſe it is not eaſy to explain why agitation ſhould be neceſſary to produce this marine light. See note on Phoſphorus, No. X.

## NOTE X.—PHOSPHORUS.

*Or mark with ſhining letters Kunkel's name*
*In the pale phoſphor's ſelf-conſuming flame.* CANTO I. l. 231.

KUNKEL, a native of Hamburgh, was the firſt who diſcovered to the world the proceſs for producing phoſphorus, though Brandt and Boyle were likewiſe ſaid to have previouſly had the art of making it. It was obtained from ſal microcoſmicum, by evaporation, in the form of an acid, but has ſince been found in other animal ſubſtances, as in the aſhes of bones, and even in ſome vegetables, as in wheat flour. Keir's Chemical Dict. This phoſphoric acid is, like all other acids, united with vital air, and requires to be treated with charcoal or phlogiſton to deprive it of this air; it then becomes a kind of animal ſulphur, but of ſo inflammable a nature, that on the acceſs of air it takes fire ſpontaneouſly, and, as it burns, becomes again united with vital air, and re-aſſumes its form of phoſphoric acid.

As animal reſpiration ſeems to be a kind of ſlow combuſtion, in which it is probable that phoſphoric acid is produced by the union of phoſphorus with the vital air, ſo it is alſo probable that phoſphoric acid is produced in the excretory or reſpiratory veſſels of luminous inſects, as the glow-worm and fire-fly, and ſome marine inſects. From the ſame principle I ſuppoſe the light from putrid fleſh, as from the heads of haddocks, and from putrid veal, and from rotten wood, in a certain ſtate of their putrefaction, is produced, and phoſphorus, thus ſlowly combined with air, is changed into phoſphoric acid. The light from the Bolognian ſtone, and from calcined ſhells, and from white paper, and linen, after having been expoſed for a time to the ſun's light, ſeem to produce either the phoſphoric or ſome other kind of acid, from the ſulphurous or phlogiſtic matter which they contain. See note on Beccari's ſhells, l. 182.

There is another proceſs ſeems ſimilar to this ſlow combuſtion, and that is *bleaching*. By the warmth and light of the ſun, the water ſprinkled upon linen or cotton cloth ſeems to be decompoſed (if we credit the theory of M. Lavoiſier), and a part of the vital air thus ſet at liberty and uncombined, and not being in its elaſtic form, more eaſily diſſolves the colouring or phlogiſtic matter of the cloth, and produces a new acid, which is itſelf colourleſs, or is waſhed out of the cloth by water. The new proceſs of bleaching confirms a part of this theory, for by uniting much vital air to marine acid, by diſtilling it from manganeſe, on dipping the cloth to be bleached in water replete with this ſuperaerated marine acid, the colouring matter diſappears immediately, ſooner indeed in cotton than in linen. See note XXXIV.

There is another proceſs which, I ſuſpect, bears analogy to theſe above-mentioned, and that is the rancidity of animal fat, as of bacon; if bacon be hung up in a warm kitchen, with much ſalt adhering on the outſide of it, the fat part of it ſoon becomes yellow and rancid; if it be waſhed with much cold water after it has imbibed the ſalt, and juſt before it is hung up, I am well informed, that it will not become rancid, or in very ſlight degrees. In the former caſe I imagine the ſalt on the ſurface of the bacon attracts water during the cold of the night, which is evaporated during the day, and that in this evaporation a part of the water becomes decompoſed, as in bleaching, and its vital air uniting with greater facility in its unelaſtic ſtate with the animal fat, produces an acid, perhaps of the phoſphoric kind, which being of a fixed nature, lies upon the bacon, giving it the yellow colour and rancid taſte. It is remarkable that the ſuperaerated marine acid does not bleach living animal ſubſtances, at leaſt it did not whiten a part of my hand which I for ſome minutes expoſed to it.

## NOTE XI.—STEAM-ENGINE.

*Quick moves the balanced beam of giant-birth,*
*Wields his large limbs, and, nodding, ſhakes the earth.* Canto I. l. 261.

THE expanſive force of ſteam was known in ſome degree to the ancients. Hero, of Alexandria, deſcribes an application of it to produce a rotative motion by the re-action of ſteam iſſuing from a ſphere mounted upon an axis, through two ſmall tubes bent into tangents, and iſſuing from the oppoſite ſides of the equatorial diameter of the ſphere; the ſphere was ſupplied with ſteam by a pipe communicating with a pan of boiling water, and entering the ſphere at one of its poles.

A French writer, about the year 1630, deſcribes a method of raiſing water to the upper part of a houſe, by filling a chamber with ſteam, and ſuffering it to condenſe of itſelf; but it ſeems to have been mere theory, as his method was ſcarcely practible as he deſcribes it. In 1655, the Marquis of Worceſter mentions a method of raiſing water by fire, in his Century of Inventions, but he ſeems only to have availed himſelf of the expanſive force, and not to have known the advantages ariſing from condenſing the ſteam by an injection of cold water. This latter and moſt important improvement ſeems to have been made by Capt. Savery, ſome time prior to 1698, for in that year his patent for the uſe of that invention was confirmed by act of parliament. This gentleman appears to have been the firſt who reduced the machine to practice, and exhibited it in an uſeful form. This method conſiſted only in expelling the air from a veſſel by ſteam, and condenſing the ſteam by an injection of cold water, which making a vacuum, the preſſure of the atmoſphere forced the water to aſcend into the ſteam-veſſel through a pipe of 24 to 26 feet high, and by the admiſſion of denſe ſteam from the boiler, forcing the water in the ſteam-veſſel to aſcend to the height deſired. This conſtruction was defective, becauſe it required very ſtrong veſſels to reſiſt the force of the ſteam, and becauſe an enormous quantity of ſteam was condenſed by coming in contact with the cold water in the ſteam-veſſel.

About, or ſoon after that time, M. Papin attempted a ſteam-engine on ſimilar principles, but rather more defective in its conſtruction.

The next improvement was made very ſoon afterwards by Meſſrs. Newcomen and Cawley, of Dartmouth; it conſiſted in employing for the ſteam-veſſel a hollow cylinder, ſhut at bottom and open at top, furniſhed with a piſton ſliding eaſily up and down in it, and made tight by oakum or hemp, and covered with water. This piſton is ſuſpended by chains from one end of a beam, moveable upon an axis in the middle of its length; to the other end of this beam are ſuſpended the pump-rods.

The danger of burſting the veſſels was avoided in this machine; as however high the water was to be raiſed, it was not neceſſary to increaſe the denſity of the ſteam, but only to enlarge the diameter of the cylinder.

Another advantage was, that the cylinder, not being made ſo cold as in

Savery's method, much leſs ſteam was loſt in filling it after each condenſation.

The machine, however, ſtill remained imperfect, for the cold water thrown into the cylinder acquired heat from the ſteam it condenſed, and being in a veſſel exhauſted of air, it produced ſteam itſelf, which, in part, reſiſted the action of the atmoſphere on the piſton; were this remedied by throwing in more cold water, the deſtruction of ſteam in the next filling of the cylinder would be proportionally increaſed. It has therefore, in practice, been found adviſeable not to load theſe engines with columns of water weighing more than ſeven pounds for each ſquare inch of the area of the piſton. The bulk of water, when converted into ſteam, remained unknown, until Mr. J. Watt, then of Glaſgow, in 1764, determined it to be about 1800 times more rare than water. It ſoon occurred to Mr. Watt, that a perfect engine would be that in which no ſteam ſhould be condenſed in filling the cylinder, and in which the ſteam ſhould be ſo perfectly cooled as to produce nearly a perfect vacuum.

Mr. Watt having aſcertained the degree of heat in which water boiled in vacuo, and under progreſſive degrees of preſſure, and inſtructed by Dr. Black's diſcovery of latent heat, having calculated the quantity of cold water neceſſary to condenſe certain quantities of ſteam ſo far as to produce the exhauſtion required, he made a communication from the cylinder to a cold veſſel previouſly exhauſted of air and water, into which the ſteam ruſhed, by its elaſticity, and became immediately condenſed. He then adapted a cover to the cylinder, and admitted ſteam above the piſton to preſs it down inſtead of air, and inſtead of applying water, he uſed oil or greaſe to fill the pores of the oakam, and to lubricate the cylinder.

He next applied a pump to extract the injection water, the condenſed ſteam, and the air, from the condenſing veſſel, every ſtroke of the engine.

To prevent the cooling of the cylinder by the contact of the external air, he ſurrounded it with a caſe containing ſteam, which he again protected by a covering of matters which conduct heat ſlowly.

This conſtruction preſented an eaſy means of regulating the power of the engine, for the ſteam being the acting power, as the pipe which admits it from the boiler is more or leſs opened, a greater or ſmaller quantity can enter during the time of a ſtroke, and, conſequently, the engine can act with exactly the neceſſary degree of energy.

Mr. Watt gained a patent for his engine in 1768, but the further proſecution of his deſigns was delayed by other avocations till 1775, when, in conjunction with Mr. Boulton, of Soho, near Birmingham, numerous experiments were made, on a large ſcale, by their united ingenuity, and great improvements added to the machinery, and an act of parliament obtained for the prolongation of their patent for twenty-five years; they have, ſince that time, drained many of the deep mines in Cornwall, which, but for the happy union of ſuch genius, muſt immediately have ceaſed to work. One of theſe engines works a pump of eighteen inches diameter, and upwards of 100 fathom, or 600 feet high, at the rate of ten to twelve ſtrokes, of ſeven feet long each, in a minute, and that with one fifth part of the coals which a common engine would have taken to do the ſame work. The power of this engine may be eaſier comprehended by ſaying, that it raiſed a weight equal to 81,000 pounds, 80 feet high, in a minute, which is equal to the combined action of 200 good horſes. In Newcomen's engine this would have required a cylinder of the enormous diameter of 120 inches, or ten feet; but as in this engine of Mr. Watt and Mr. Boulton the ſteam acts, and a vacuum is made, alternately above and below the piſton, the power exerted is double to what the ſame cylinder would otherways produce, and is further augmented by an inequality in the length of the two ends of the lever.

Theſe gentlemen have alſo, by other contrivances, applied their engines to the turning of mills for almoſt every purpoſe, of which that great pile of machinery, the Albion Mill, is a well known inſtance. Forges, ſlitting mills, and other great works, are erected where nature has furniſhed no running water, and future times may boaſt that this grand and uſeful engine was invented and perfected in our own country.

Since the above article went to the preſs, the Albion Mill is no more; it is ſuppoſed to have been ſet on fire by intereſted or malicious incendiaries, and is burnt to the ground. Whence London has loſt the credit and the advantage of poſſeſſing the moſt powerful machine in the world.

## NOTE XII.—FROST.

*In phalanx firm, the Fiend of Froſt aſſail.* CANTO I. l. 439.

THE cauſe of the expanſion of water during its converſion into ice, is not yet well aſcertained; it was ſuppoſed to have been owing to the air being ſet at liberty in the act of congelation, which was before diſſolved in the water, and the many air bubbles in ice were thought to countenance this opinion. But the great force with which ice expands during its congelation, ſo as to burſt iron bombs and coehorns, according to the experiments of Major Williams, at Quebec, invalidates this idea of the cauſe of it, and may ſome time be brought into uſe as a means of breaking rocks in mining, or projecting cannon-balls, or for other mechanical purpoſes, if the means of producing congelation ſhould ever be diſcovered to be as eaſy as the means of producing combuſtion.

Mr. de Mairan attributes the increaſe of bulk of frozen water to the different arrangement of the particles of it in cryſtallization, as they are conſtantly joined at an angle of 60 degrees, and muſt, by this diſpoſition, he thinks, occupy a greater volume than if they were parallel. He found the augmentation of the water, during freezing, to amount to one-fourteenth, one-eighteenth, one-nineteenth, and when the water was previouſly purged of air, to only one-twenty-ſecond part. He adds, that a piece of ice, which was at firſt only one-fourteenth part ſpecifically lighter than water, on being expoſed ſome days to the froſt, became one-twelfth lighter than water. Hence he thinks ice, by being expoſed to greater cold, ſtill increaſes in volume; and to this attributes the burſting of ice in ponds, and on the glaciers. See Lewis's Commerce of Arts, p. 257, and the note on Muſchus, in the ſecond part of this work.

This expanſion of ice well accounts for the greater miſchief done by vernal froſts attended with moiſture (as by hoar froſts), than by the dry froſts, called black froſts. Mr. Lawrence, in a letter to Mr. Bradley, complains that the dale-miſt, attended with a froſt, on May-day, had deſtroyed all his tender fruits; though there was a ſharper froſt the night before, without a miſt, that did him no injury; and adds, that a garden not a ſtone's throw from his own, on a higher ſituation, being above the dale-miſt, had received no damage. Bradley, vol. II. p. 232.

Mr. Hunter, by very curious experiments, diſcovered that the living principle in fiſh, in vegetables, and even in eggs and ſeeds, poſſeſſes a power of reſiſting congelation. Phil. Tranſ. There can be no doubt but that the exertions of animals to avoid the pain of cold, may produce in them a greater quantity of heat, at leaſt for a time; but that vegetables, eggs, or ſeeds, ſhould poſſeſs ſuch a quality, is truly wonderful. Others have imagined that animals poſſeſs a power of preventing themſelves from becoming much warmer than 98 degrees of heat, when immerſed in an atmoſphere above that degree of heat. It is true that the increaſed exhalation from their bodies will, in ſome meaſure, cool them, as much heat is carried off by the evaporation of fluids; but this is a chemical, not an animal proceſs. The experiments made by thoſe who continued many minutes in the air of a room heated ſo much above any natural atmoſpheric heat, do not ſeem concluſive, as they remained in it a leſs time than would have been neceſſary to have heated a maſs of beef of the ſame magnitude; and the circulation of the blood in living animals, by perpetually bringing new ſupplies of fluid to the ſkin, would prevent the external ſurface from becoming hot much ſooner than the whole maſs. And, thirdly, there appears no power of animal bodies to produce cold in diſeaſes, as in ſcarlet fever, in which the increaſed action of the veſſels of the ſkin produces heat, and contributes to exhauſt the animal power already to much weakened.

It has been thought by many that froſts meliorate the ground, and that they are in general ſalubrious to mankind. In reſpect to the former, it is now well known that ice or ſnow contains no nitrous particles, and though froſt, by enlarging the bulk of moiſt clay, leaves it ſofter for a time after the thaw, yet as ſoon as the water exhales, the clay becomes as hard as before, being preſſed together by the incumbent atmoſphere, and by its ſelf-attraction, called *ſetting* by the potters. Add to this, that on the coaſts of Africa, where froſt is unknown, the fertility of the ſoil is almoſt beyond our conceptions of it. In reſpect to the general ſalubrity of froſty ſeaſons, the bills of mortality are an evidence in the negative, as in long froſts many weakly and old people periſh from debility occaſioned by the cold, and many claſſes of birds, and other wild animals, are benumbed by the cold, or deſtroyed by the conſequent ſcarcity of food, and many tender vegetables periſh from the degree of cold.

I do not think it ſhould be objected to this doctrine, that there are moiſt days, attended with a briſk cold wind, when no viſible ice appears, and which are yet more diſagreeable and deſtructive than froſty weather. For on theſe days the cold moiſture which is depoſited on the ſkin is there evaporated, and thus produces a degree of cold perhaps greater than the milder froſts. Whence, even in ſuch days, both the diſagreeable ſenſations and inſalubrious effects belong to the cauſe above-mentioned, viz. the intenſity of the cold. Add to this, that in theſe cold moiſt days, as we paſs along, or as the wind blows upon us, a new ſheet of cold water is, as it were, perpetually applied to us, and hangs upon our bodies. Now, as water is 800 times denſer than air, and is a much better conductor of heat, we are ſtarved with cold, like thoſe who go into a cold bath, both by the great number of particles in contact with the ſkin, and their great facility of receiving our heat.

It may nevertheleſs be true, that ſnows of long duration, in our winters, may be leſs injurious to vegetation than great rains and ſhorter froſts, for two reaſons. 1. Becauſe great rains carry down many thouſand pounds worth of the beſt part of the manure off the lands into the ſea, whereas ſnow diſſolves more gradually, and thence carries away leſs from the land. Any one may diſtinguiſh a ſnow-flood from a rain-flood by the tranſparency of the water. Hence hills or fields, with conſiderable inclination of ſurface, ſhould be ploughed horizontally, that the furrows may ſtay the water from ſhowers till it depoſits its mud. 2. Snow protects vegetables from the ſeverity of the froſt, ſince it is always in a ſtate of thaw where it is in contact with the earth; as the earth's heat is about 48 degrees, and the heat of thawing ſnow is 32 degrees, the vegetables between them are kept in a degree of heat about 40, by which many of them are preſerved. See note on Muſchus, part II. of this work.

## NOTE XIII.—ELECTRICITY.

*Cold from each point cerulean luſtres gleam.* CANTO I. l. 339.

### ELECTRIC POINTS.

THERE was an idle diſpute, whether knobs or points were preferable on the top of conductors, for the defence of houſes. The deſign of theſe conductors is to permit the electric matter accumulated in the clouds, to paſs through them into the earth in a ſmaller continued ſtream as the cloud approaches, before it comes to what is termed ſtriking diſtance. Now, as it is well known that accumulated electricity will paſs to points at a much greater diſtance than it will to knobs, there can be no doubt of their preference; and it would ſeem, that the finer the points, and the leſs liable to become ruſty, the better, as it would take off the lightning while it was ſtill at a greater diſtance, and by that means preſerve a greater extent of building.

The very extremity of the point ſhould be of pure ſilver or gold, and might be branched into a kind of bruſh, ſince one ſmall point cannot be ſuppoſed to receive ſo great a quantity as a thicker bar might conduct into the earth.

If an inſulated metallic ball is armed with a point, like a needle, projecting from one part of it, the electric fluid will be ſeen in the dark to paſs off from this point, ſo long as the ball is kept ſupplied with electricity. The reaſon of this is not difficult to comprehend: Every part of the electric atmoſphere which ſurrounds the inſulated ball, is attracted to that ball by a large ſurface of it, whereas the electric atmoſphere which is near the extremity of the needle, is attracted to it only by a ſingle point; in conſequence, the particles of electric matter, near the ſurface of the ball, approach towards it, and puſh off, by their greater gravitation, the particles of electric matter over the point of the needle, in a continued ſtream.

Something like this happens in reſpect to the diffuſion of oil on water from a pointed cork, an experiment which was many years ago ſhewn me by Dr. Franklin. He cut a piece of cork about the ſize of a letter-wafer, and left on one edge of it a point about a ſixth of an inch in length, projecting as a tangent to the circumference. This was dipped in oil, and thrown on a pond of water, and continued to revolve, as the oil left the point, for a great many minutes. The oil deſcends from the floating cork upon the water, being diffuſed upon it without friction, and perhaps without contact; but its going off at the point ſo forcibly as to make that cork revolve in a contrary direction, ſeems analogous to the departure of the electric fluid from points.

Can any thing ſimilar to either of theſe happen in reſpect to the earth's atmoſphere, and give occaſion to the breezes on the tops of mountains, which may be conſidered as points on the earth's circumference?

## FAIRY-RINGS.

There is a phenomenon ſuppoſed to be electric which is yet unaccounted for; I mean the Fairy-rings, as they are called, ſo often ſeen on the graſs. The numerous flaſhes of lightning which occur every ſummer, are, I believe, generally diſcharged on the earth, and but ſeldom (if ever) from one cloud to another. Moiſt trees are the moſt frequent conductors of theſe flaſhes of lightning, and I am informed by purchaſers of wood, that innumerable trees are thus cracked and injured. At other times larger parts or prominences of clouds, gradually ſinking as they move along, are diſcharged on the moiſter parts of graſſy plains. Now, this knob or corner of a cloud, in being attracted by the earth, will become nearly cylindrical, as looſe wool would do when drawn out into a thread, and will ſtrike the earth with a ſtream of electricity, perhaps two or ten yards in diameter. Now, as a ſtream of electricity diſplaces the air it paſſes through, it is plain no part of the graſs can be burnt by it, but juſt the external ring of this cylinder, where the graſs can have acceſs to the air, ſince without air nothing can be calcined. This earth, after having been ſo calcined, becomes a richer ſoil, and either funguſes or a bluer graſs for many years mark the place. That lightning diſplaces the air in its paſſage is evinced by the loud crack that ſucceeds it, which is owing to the ſides of the aerial vacuum clapping together when the lightning is withdrawn. That nothing will calcine without air is now well underſtood from the acids produced in the burning of phlogiſtic ſubſtances, and may be agreeably ſeen by ſuſpending a paper on an iron prong, and putting it into the centre of the blaze of an iron-furnace; it may be held there ſome ſeconds, and may be again withdrawn without its being burnt, if it be paſſed quickly into the flame and out again, through the external part of it, which is in contact with the air. I know ſome circles of many yards diameter of this kind, near Foremark, in Derbyſhire, which annually produce large white funguſes, and ſtronger graſs, and have done ſo, I am informed, above thirty years. This increaſed fertility of the ground by calcination or charring, and its continuing to operate ſo many years, is well worth the attention of the farmer, and ſhews the uſe of paring and burning new turf in agriculture, which produces its effect not ſo much by the aſhes of the vegetable fibres, as by charring the ſoil which adheres to them.

Theſe ſituations, whether from eminence or from moiſture, which were proper once to attract and diſcharge a thunder-cloud, are more liable again to experience the ſame. Hence many fairy-rings are often ſeen near each other, either without interſecting each other, as I ſaw this ſummer in a garden in Nottinghamſhire, or interſecting each other, as deſcribed on Arthur's ſeat, near Edinburgh, in the Edinb. Tranſ. vol. II. p. 3.

## NOTE XIV.—BUDS AND BULBS.

*Where dwell my vegetative realms benumb'd,*
*In buds impriſon'd, or in bulbs intomb'd.* Canto I. l. 459.

A TREE is, properly ſpeaking, a family or ſwarm of buds, each bud being an individual plant; for if one of theſe buds be torn or cut out, and planted in the earth, with a glaſs cup inverted over it, to prevent its exhalation from being at firſt greater than its power of abſorption, it will produce a tree ſimilar to its parent; each bud has a leaf, which is its lungs, appropriated to it, and the bark of the tree is a congeries of the roots of theſe individual buds; whence old hollow trees are often ſeen to have ſome branches flouriſh with vigour after the internal wood is almoſt entirely decayed and vaniſhed. According to this idea, Linnæus has obſerved, that trees and ſhrubs are roots above ground, for if a tree be inverted, leaves will grow from the root-part, and roots from the trunk-part. Phil. Bot. p. 39. Hence it appears that vegetables have two methods of propagating themſelves, the oviparous as by ſeeds, and the viviparous as by their buds and bulbs; and that the individual plants, whether from ſeeds, or buds, or bulbs, are all annual productions, like many kinds of inſects, as the ſilk-worm;

the parent periſhing in the autumn after having produced an embryon, which lies in a torpid ſtate during the winter, and is matured in the ſucceeding ſummer. Hence Linnæus names buds and bulbs the winter cradles of the plant, or hybernacula, and might have given the ſame term to ſeeds. In warm climates few plants produce buds, as the vegetable life can be completed in one ſummer, and hence the hybernacle is not wanted; in cold climates alſo ſome plants do not produce buds, as philadelphus, frangula, viburnum, ivy, heath, wood-nightſhade, rue, geranium.

The bulbs of plants are another kind of winter cradle, or hybernacle, adhering to the deſcending trunk, and are found in the perennial herbaceous plants, which are too tender to bear the cold of the winter. The production of theſe ſubterraneous winter lodges, is not yet, perhaps, clearly underſtood; they have been diſtributed by Linnæus, according to their forms, into ſcaly, ſolid, coated, and jointed bulbs, which, however, does not elucidate their manner of production. As the buds of trees may be truly eſteemed individual annual plants, their roots conſtituting the bark of the trees, it follows, that theſe roots (viz. of each individual bud) ſpread themſelves over the laſt year's bark, making a new bark over the old one, and thence deſcending, cover with a new bark the old roots alſo in the ſame manner. A ſimilar circumſtance I ſuppoſe to happen in ſome herbaceous plants, that is, a new bark is annually produced over the old root, and thus, for ſome years at leaſt, the old root or caudex increaſes in ſize, and puts up new ſtems. As theſe roots increaſe in ſize, the central part, I ſuppoſe, changes like the internal wood of a tree, and does not poſſeſs any vegetable life, and therefore gives out no fibres or rootlets, and hence appears bitten off, as in valerian, plantain, and devil's-bit. And this decay of the central part of the root, I ſuppoſe, has given occaſion to the belief of the root-fibres drawing down the bulb, ſo much inſiſted on by Mr. Milne, in his Botanical Dictionary, art. Bulb.

From the obſervations and drawings of various kinds, of bulbous roots, at different times of their growth, ſent me by a young lady of nice obſervation, it appears probable that all bulbous roots, properly ſo called, periſh annually in this climate. Bradley, Miller, and the author of Spectacle de la Nature, obſerve that the tulip annually renews its bulb, for the ſtalk of the old flower is found under the old dry coat, but on the outſide of the new bulb. This large new bulb is the flowering bulb; but beſides this there are other ſmall new bulbs produced between the coats of this large one, but from the ſame caudex (or circle from which the root-fibres ſpring); theſe ſmall bulbs are leaf-bearing bulbs, and renew themſelves annually, with increaſing ſize, till they bear flowers.

Miſs ——— favoured me with the following curious experiment: She took a ſmall tulip-root out of the earth when the green leaves were ſufficiently high to ſhow the flower, and placed it in a glaſs of water; the leaves and flower ſoon withered, and the bulb became wrinkled and ſoft, but put out one ſmall ſide bulb, and three bulbs beneath, deſcending an inch into the water by proceſſes from the caudex; the old bulb in ſome weeks entirely decayed. On diſſecting this monſter, the middle deſcending bulb was found, by its proceſs, to adhere to the caudex, and to the old flower-ſtem; and the ſide ones were ſeparated from the flower-ſtem by a few ſhrivelled coats, but adhered to the caudex. Whence ſhe concludes that theſe laſt were off-ſets, or leaf-bulbs, which ſhould have been ſeen between the coats of the new flower-bulb, if it had been left to grow in the earth, and that the middle one would have been the new flower-bulb. In ſome years (perhaps in wet ſeaſons) the floriſts are ſaid to loſe many of their tulip-roots by a ſimilar proceſs, the new leaf-bulbs being produced beneath the old ones by an elongation of the caudex, without any new flower-bulbs.

By repeated diſſections, ſhe obſerves, that the leaf-bulbs, or off-ſets of tulip, crocus, gladiolus, fritillary, are renewed in the ſame manner as the flowering-bulbs, contrary to the opinion of many writers; this new leaf-bulb is formed on the inſide of the coats from whence the leaves grow, and is more or leſs advanced in ſize as the outer coats and leaves are more or leſs ſhrivelled. In examining tulip, iris, hyacinth, hare-bell, the new bulb was invariably found *between* the flower-ſtem and the baſe of the innermoſt leaf of thoſe roots which had flowered, and *incloſed by* the baſe of the innermoſt leaf in thoſe roots which had not flowered, in both caſes adhering to the caudex or fleſhy circle from which the root-fibres ſpring.

Hence it is probable that the bulbs of hyacinths are renewed annually, but that this is performed from the caudex within the old bulb, the outer coat of which does not ſo ſhrivel as in crocus and fritillary, and hence this change is not ſo apparent. But, I believe, as ſoon as the flower is advanced, the new bulbs may be ſeen on diſſection; nor does the annual increaſe of the ſize of the root of cyclamen, and of aletris capenſis, militate againſt this annual renewal of them, ſince the leaf-bulbs, or off-ſets, as deſcribed above, are increaſed in ſize as they are annually renewed. See note on Orchis, and on Anthoxanthum, in Part II. of this work.

## NOTE XV.—SOLAR VOLCANOS.

*From the deep craters of his realms of fire*
*The whirling Sun this ponderous planet hurl'd.* CANTO II. l. 14.

DR. ALEXANDER WILSON, Profeſſor of Aſtronomy at Glaſgow, publiſhed a paper in the Philoſophical Tranſactions for 1774, demonſtrating that the ſpots in the ſun's diſk are real cavities, excavations through the luminous material, which covers the other parts of the ſun's ſurface. One of theſe cavities he found to be about 4000 miles deep, and many times as wide. Some objections were made to this doctrine by M. De la Lande, in the Memoirs of the French Academy for the year 1776, which, however, have been ably anſwered by profeſſor Wilſon in reply, in the Philoſ. Tranſ. for 1783. Keil obſerves, in his Aſtronomical Lectures, p. 44, "We frequently ſee ſpots in the ſun which are larger and broader not only than Europe or Africa, but which even equal, if they do not exceed, the ſurface of the whole terraqueous globe." Now that theſe cavities are made in the ſun's body by a proceſs of nature ſimilar to our earthquakes, does not ſeem improbable on ſeveral accounts. 1. Becauſe, from this diſcovery of Dr. Wilſon, it appears that the internal parts of the ſun are not in a ſtate of inflammation or of ejecting light, like the external part or luminous ocean which covers it; and hence that a greater degree of heat or inflammation, and conſequent expanſion or exploſion, may occaſionally be produced in its internal or dark nucleus. 2. Becauſe the ſolar ſpots or cavities are frequently increaſed or diminiſhed in ſize. 3. New ones are often produced. 4. And old ones vaniſh. 5. Becauſe there are brighter or more luminous parts of the ſun's diſk, called faculæ by Scheiner and Hevelius, which would ſeem to be volcanos in the ſun, or, as Dr. Wilſon calls them, " eructations of matter more luminous than that which covers the ſun's ſurface." 6. To which may be added that all the planets added together, with their ſatellites, do not amount to more than one ſix hundred and fiftieth part of the maſs of the ſun, according to Sir Iſaac Newton.

Now, if it could be ſuppoſed that the planets were originally thrown out of the ſun by larger ſun-quakes than thoſe frequent ones which occaſion theſe ſpots or excavations above-mentioned, what would happen? 1. According to the obſervations and opinion of Mr. Herſchel, the ſun itſelf and all its planets are moving forwards round ſome other centre with an unknown velocity, which may be of opake matter, correſponding with the very ancient and general idea of a chaos. Whence, if a ponderous planet, as Saturn, could be ſuppoſed to be projected from the ſun by an exploſion, the motion of the ſun itſelf might be at the ſame time diſturbed in ſuch a manner as to prevent the planet from falling again into it. 2. As the ſun revolves round its own axis, its form muſt be that of an oblate ſpheroid like the earth, and therefore a body projected from its ſurface perpendicularly upwards from that ſurface would not riſe perpendicularly from the ſun's centre, unleſs it happened to be projected exactly from either of its poles or from its equator. Whence it may not be neceſſary that a planet, if thus projected from the ſun by exploſion, ſhould again fall into the ſun. 3. They would part from the ſun's ſurface with the velocity with which that ſurface was moving, and with the velocity acquired by the exploſion, and would therefore move round the ſun in the ſame direction in which the ſun rotates on its axis, and perform eliptic orbits. 4. All the planets would move the ſame way round the ſun, from this firſt motion acquired at leaving its ſurface, but their orbits would be inclined to each other according to the diſtance of the part, where they were thrown out, from the ſun's equator. Hence thoſe which were ejected near the ſun's equator would have orbits but little inclined to each other, as the primary planets; the plain of all whoſe orbits are inclined but ſeven degrees and a half from each other. Others which were ejected near the ſun's poles would have much more eccentric orbits, as they would partake ſo much leſs of the ſun's rotatory motion at the time they parted from his ſurface, and would, therefore, be carried further from the ſun by the velocity they had gained by the exploſion which ejected them, and become comets. 5. They would all obey the ſame laws of motion in their revolutions round the ſun; this has been determined by aſtronomers, who have demonſtrated that they move through equal areas, in equal times. 6. As their annual periods would depend on the height they roſe by the exploſion, theſe would differ in them all. 7. As their diurnal revolutions would depend on one ſide of the exploded matter adhering more than the other at the time it was torn off by the exploſion, theſe would alſo differ in the different planets, and not bear any proportion to their annual periods. Now, as all theſe circumſtances coincide with the known laws of the planetary ſyſtem, they ſerve to ſtrenghten this conjecture.

This coincidence of ſuch a variety of circumſtances induced M. de Buffon to ſuppoſe that the planets were all ſtruck off from the ſun's ſurface by the impact of a large comet, ſuch as approached ſo near the ſun's diſk, and with ſuch amazing velocity, in the year 1680, and is expected to return in 2255. But Mr. Buffon did not recollect that theſe comets themſelves are only planets with more eccentric orbits, and that therefore it muſt be aſked, what had previouſly ſtruck off theſe comets from the ſun's body? 2. That if all theſe planets were ſtruck off from the ſun at the ſame time, they muſt have been ſo near as to have attracted each other and have formed one maſs. 3. That we ſhall want new cauſes for ſeparating the ſecondary planets from the primary ones, and muſt therefore look out for ſome other agent, as it does not appear how the impulſe of a comet could have made one planet roll round another at the time they both of them were driven off from the ſurface of the ſun.

If it ſhould be aſked, why new planets are not frequently ejected from the ſun? it may be anſwered, that after many large earthquakes many vents are left for the elaſtic vapours to eſcape, and hence, by the preſent appearance of the ſurface of our earth, earthquakes, prodigiouſly larger than any recorded in hiſtory, have exiſted; the ſame circumſtances may have affected the ſun, on whoſe ſurface there are appearances of volcanos, as deſcribed above. Add to this, that ſome of the comets, and even the georgium ſidus, may, for aught we know to the contrary, have been emitted from the ſun in more modern days, and have been diverted from their courſe, and thus pervented from returning into the ſun, by their approach to ſome of the older planets, which is ſomewhat countenanced by the opinion ſeveral philoſophers have maintained, that the quantity of matter of the ſun has decreaſed. Dr. Halley obſerved, by comparing the proportion which the periodical time of the moon bore to that of the ſun in former times, with the proportion between them at preſent, that the moon is found to be ſomewhat accelerated in reſpect to the ſun. Pemberton's View of Sir Iſaac Newton, p. 247. And ſo large is the body of this mighty luminary, that all the planets thus thrown out of it would make ſcarce any perceptible diminution of it as mentioned above. The cavity mentioned above, as meaſured by Dr. Wilſon, of 4000 miles in depth, not penetrating an hundredth part of the ſun's ſemi-diameter; and yet as its width was many times greater than its depth, was large enough to contain a greater body than our terreſtrial world.

I do not mean to conceal, that from the laws of gravity unfolded by Sir Iſaac Newton, ſuppoſing the ſun to be a ſphere, and to have no progreſſive motion, and not liable itſelf to be diſturbed by the ſuppoſed projection of the planets from it, that ſuch planets muſt return into the ſun. The late Rev. William Ludlam, of Leiceſter, whoſe genius never met with reward equal to its merits, in a letter to me, dated January, 1787, after having ſhewn, as mentioned above, that planets ſo projected from the ſun would return to it, adds, "That a body as large as the moon ſo projected, would "diſturb the motion of the earth in its orbit, is certain; but the calculation "of ſuch diſturbing forces is difficult. The body in ſome circumſtances "might become a ſatellite, and both move round their common centre of "gravity, and that centre be carried in an annual orbit round the ſun."

There are other circumſtances which might have concurred at the time of ſuch ſuppoſed exploſions, which would render this idea not impoſſible. 1. The planets might be thrown out of the ſun at the time the ſun itſelf was riſing from chaos, and be attracted by other ſuns in their vicinity riſing at the ſame time out of chaos, which would prevent them from returning into the ſun. 2. The new planet, in its courſe or aſcent from the ſun, might explode and eject a ſatellite, or perhaps more than one, and thus, by its courſe being affected, might not return into the ſun. 3. If more planets were ejected at the ſame time from the ſun, they might attract and diſturb each others courſe at the time they left the body of the ſun, or very ſoon afterwards, when they would be ſo much nearer each other.

## NOTE XVI.—CALCAREOUS EARTH.

*While Ocean wrap'd it in his azure robe.* CANTO II. l. 34.

FROM having obſerved that many of the higheſt mountains of the world conſiſt of lime-ſtone replete with ſhells, and that theſe mountains bear the marks of having been lifted up by ſubterraneous fires from the interior parts of the globe; and as lime-ſtone replete with ſhells is found at the bottom of many of our deepeſt mines, ſome philoſophers have concluded that the nucleus of the earth was for many ages covered with water, which was peopled with its adapted animals; that the ſhells and bones of theſe animals, in a long ſeries of time, produced ſolid ſtrata in the ocean ſurrounding the original nucleus.

Theſe ſtrata conſiſt of the accumulated exuviæ of ſhell-fiſh—the animals periſhed age after age, but their ſhells remained, and, in progreſſion of time, produced the amazing quantities of lime-ſtone which almoſt cover the earth. Other marine-animals, called coralloids, raiſed walls, and even mountains, by the congeries of their calcareous habitations; theſe perpendicular coralline rocks make ſome parts of the ſouthern ocean highly dangerous, as appears in the journals of Capt. Cook. From contemplating the immenſe ſtrata of lime-ſtone, both in reſpect to their extent and thickneſs, formed from theſe ſhells of animals, philoſophers have been led to conclude, that much of the water of the ſea has been converted into calcareous earth, by paſſing through their organs of digeſtion. The formation of calcareous earth ſeems more particularly to be an animal proceſs, as the formation of clay belongs to the vegetable economy; thus the ſhells of crabs, and other teſtaceous fiſh, are annually re-produced from the mucous membrane beneath them; the ſhells of eggs are firſt a mucous membrane, and the calculi of the kidneys, and thoſe found in all other parts of our ſyſtem, which ſometimes contain calcareous earth, ſeem to originate from inflamed membranes; the bones themſelves conſiſt of calcareous earth united with the phoſphoric or animal acid, which may be ſeparated by diſſolving the aſhes of calcined bones in the nitrous acid; the various ſecretions of animals, as their ſaliva and urine, abound likewiſe with calcareous earth, as appears by the incruſtations about the teeth, and the ſediments of urine. It is probable that animal mucus is a previous proceſs towards the formation of calcareous earth; and that all the calcareous earth in the world, which is ſeen in lime-ſtones, marbles, ſpars, alabaſters, marls (which make up the greateſt part of the earth's cruſt, as far as it has yet been penetrated), have been formed originally by animal and vegetable bodies from the maſs of water, and that by theſe means the ſolid part of the terraqueous globe has perpetually been in an increaſing ſtate, and the water perpetually in a decreaſing one.

After the mountains of ſhells, and other recrements of aquatic animals, were elevated above the water, the upper heaps of them were gradually diſſolved by rains and dews, and oozing through, were either perfectly cryſtallized in ſmaller cavities, and formed calcareous ſpar, or were imperfectly cryſtallized on the roofs of larger cavities, and produced ſtalactites; or mixing with other undiſſolved ſhells beneath them, formed marbles, which were more or leſs cryſtallized and more or leſs pure; or, laſtly, after being diſſolved, the water was exhaled from them in ſuch a manner that the external parts became ſolid, and, forming an arch, prevented the internal parts from approaching each other ſo near as to become ſolid, and thus chalk was produced. I have ſpecimens of chalk formed at the root of ſeveral ſtalactites, and in their central parts; and of other ſtalactites, which are hollow like quills, from a ſimilar cauſe, viz. from the external part of the ſtalactite hardening firſt by its evaporation, and thus either attracting the internal diſſolved particles to the cruſt, or preventing them from approaching each other ſo as to form a ſolid body. Of theſe I ſaw many hanging from the arched roof of a cellar under the high ſtreet in Edinburgh.

If this diſſolved lime-ſtone met with vitriolic acid, it was converted into alabaſter, parting at the ſame time with its fixable air. If it met with the fluor acid, it became fluor; if with the ſiliceous acid, flint; and when mixed with clay and ſand, or either of them, acquires the name of marl. And under one or other of theſe forms, compoſes a great part of the ſolid globe of the earth.

Another mode in which lime-ſtone appears is in the form of round granulated particles, but ſlightly cohering together; of this kind a bed extends over Lincoln heath, perhaps twenty miles long by ten wide. The form of this calcareous ſand, its angles having been rubbed off, and the flatneſs of its bed, evince that that part of the country was ſo formed under water, the particles of ſand having thus been rounded, like all other rounded pebbles, This round form of calcareous ſand, and of other larger pebbles, is produced under water, partly by their being more or leſs ſoluble in water, and hence the angular parts become diſſolved; firſt, by their expoſing a larger ſurface to the action of the menſtruum; and, ſecondly, from their attrition againſt each other by the ſtreams or tides, for a great length of time, ſucceſſively, as they were collected, and, perhaps, when ſome of them had not acquired their hardeſt ſtate.

This calcareous ſand has generally been called ketton-ſtone, and believed to reſemble the ſpawn of fiſh; it has acquired a form ſo much rounder than ſiliceous ſand, from its being of ſo much ſofter a texture, and alſo much more ſoluble in water. There are other ſoft calcareous ſtones called tupha, which are depoſited from water on moſſes, as at Matlock, from which moſs it is probable the water may receive ſomething which induces it the readier to part with its earth.

In ſome lime-ſtones the living animals ſeem to have been buried, as well as their ſhells, during ſome great convulſion of nature. Theſe ſhells contain a black coaly ſubſtance within them, in others ſome phlogiſton or volatile alkali, from the bodies of the dead animals, remains mixed with the ſtone, which is then called liver-ſtone, as it emits a ſulphurous ſmell on being ſtruck; and there is a ſtratum about ſix inches thick extends a conſiderable way over the iron-ore at Wingerworth, near Cheſterfield, in Derbyſhire, which ſeems evidently to have been formed from the ſhells of freſh-water muſcles.

There is, however, another ſource of calcareous earth beſides the aquatic one above deſcribed, and that is from the recrements of land animals and vegetables, as found in marls, which conſiſt of various mixtures of calcareous earth, ſand, and clay, all of them, perhaps, principally from vegetable origin.

Dr. Hutton is of opinion, that the rocks of marble have been ſoftened by fire into a fluid maſs, which, he thinks, under immenſe preſſure, might be done without the eſcape of their carbonic acid or fixed air. Edinb. Tranſ. vol. I. If this ingenious idea be allowed, it might account for the purity of ſome white marbles, as during their fluid ſtate there might be time for their partial impurities, whether from the bodies of the animals which produced the ſhells, or from other extraneous matter, either to ſublime to the uppermoſt part of the ſtratum, or to ſubſide to the lowermoſt part of it. As a confirmation of this theory of Dr. Hutton's, it may be added, that ſome calcareous ſtones are found mixed with lime, and have thence loſt a part of their fixed air, or carbonic gas, as the bath-ſtone, and, on that account, hardens on being expoſed to the air, and, mixed with ſulphur, produces calcareous liver of ſulphur. Falconer on Bath-water, vol. I. p. 156 and p. 257. Mr. Monnet found lime in powder in the mountains of Auvergne, and ſuſpected it of volcanic origin. Kirwan's Min. p. 22.

## NOTE XVII.—MORASSES.

*Gnomes! you then taught tranſuding dews to paſs*
*Through time-fall'n woods, and root-inwove moraſs.* CANTO II. l. 115.

WHERE woods have repeatedly grown and periſhed, moraſſes are, in proceſs of time, produced, and by their long roots, fill up the interſtices till the whole becomes, for many yards deep, a maſs of vegetation. This fact is curiouſly verified by an account given many years ago by the Earl of Cromartie, of which the following is a ſhort abſtract.

In the year 1651, the Earl of Cromartie, being then nineteen years of age, ſaw a plain in the pariſh of Lockburn covered over with a firm ſtanding wood, which was ſo old that not only the trees had no green leaves upon them, but the bark was totally thrown off, which, he was there informed by the old countrymen, was the univerſal manner in which fir-woods terminated, and that in twenty or thirty years the trees would caſt themſelves up by the roots. About fifteen years after he had occaſion to travel the ſame way, and obſerved that there was not a tree nor the appearance of a root of any of them; but in their place, the whole plain where the wood ſtood was covered with a flat green moſs, or moraſs, and on aſking the country people what was become of the wood, he was informed that no one had been at the trouble to carry it away, but that it had all been overturned by the wind, that the trees lay thick over each other, and that the moſs or bog had overgrown the whole timber, which, they added, was occaſioned by the moiſture which came down from the high hills above it, and ſtagnated upon the plain, and that nobody could yet paſs over it, which, however, his Lordſhip was ſo incautious as to attempt, and ſlipt up to the arm-pits. Before the year 1699, that whole piece of ground was become a ſolid moſs, wherein the peaſants then dug turf or peat, which, however, was not yet of the beſt ſort. Phil. Tranſ. No. 330. Abridg. vol. V. p. 272.

Moraſſes in great length of time undergo variety of changes, firſt by elutriation, and afterwards by fermentation, and the conſequent heat. 1. By water perpetually oozing through them the moſt ſoluble parts are firſt waſhed away, as the eſſential ſalts; theſe, together with the ſalts from animal recrements, are carried down the rivers into the ſea, where all of them ſeem to decompoſe each other except the marine ſalt. Hence the aſhes of peat contain little or no vegetable alkali, and are not uſed in the countries where peat conſtitutes the fuel of the lower people, for the purpoſe of waſhing linen. The ſecond thing which is always ſeen oozing from moraſſes is iron in ſolution, which produces chalybeat ſprings, from whence depoſitions of ochre and variety of iron ores. The third elutriation ſeems to conſiſt of vegetable acid, which by means unknown appears to be converted into all other acids. 1. Into marine and nitrous acids as mentioned above. 2. Into vitriolic acid, which is found in ſome moraſſes ſo plentifully as to preſerve the bodies of animals from putrefaction which have been buried in them, and this acid, carried away by rain and dews, and meeting with calcareous earth, produces gypſum or alabaſter, with clay it produces alum, and, deprived of its vital air, produces ſulphur. 3. Fluor acid, which being waſhed away, and meeting with calcareous earth, produces fluor or cubic ſpar. 4. The ſiliceous acid, which ſeems to have been diſſeminated in great quantity either by ſolution in water or by ſolution in air, and appears to have produced the ſand in the ſea, uniting with calcareous earth, previouſly diſſolved in that element, from which were afterwards formed ſome of the grit-ſtone rocks by means of a ſiliceous or calcareous cement. By its union with the calcareous earth of the moraſs, other ſtrata of ſiliceous ſand have been produced; and by the mixture of this with clay and lime aroſe the beds of marl.

In other circumſtances, probably where leſs moiſture has prevailed, moraſſes ſeem to have undergone a fermentation, as other vegetable matter, new hay, for inſtance, is liable to do from the great quantity of ſugar it contains. From the great heat thus produced in the lower parts of immenſe beds of moraſs, the phlogiſtic part, or oil, or aſphaltum, becomes diſtilled, and riſing into higher ſtrata, becomes again condenſed, forming coal-beds of greater or leſs purity according to their greater or leſs quantity of inflammable matter; at the ſame time the clay-beds become purer or leſs ſo, as the phlogiſtic part is more or leſs completely exhaled from them. Though coal and clay are frequently produced in this manner, yet I have no doubt, but that they are likewiſe often produced by elutriation; in ſituations on declivities the clay is waſhed away down into the valleys, and the phlogiſtic part or coal left behind; this circumſtance is ſeen in many valleys near the beds of rivers, which are covered recently by a whitiſh impure clay, called water-clay. See note XIX. XX. and XXIII.

Lord Cromartie has furniſhed another curious obſervation on moraſſes in the paper above refered to. In a moſs near the town of Eglin, in Murray, though there is no river or water which communicates with the moſs, yet for three or four feet of depth in the moſs there are little ſhell-fiſh reſembling oyſters, with living fiſh in them in great quantities, though no ſuch fiſh are found in the adjacent rivers, nor even in the water pits in the moſs, but only in the ſolid ſubſtance of the moſs. This curious fact not only accounts for the ſhells ſometimes found on the ſurface of coals, and in the clay above them, but alſo for a thin ſtratum of ſhells which ſometimes exiſt over iron-ore.

## NOTE XVIII.—IRON.

*Cold waves, immerſed, the glowing maſs congeal,*
*And turn to adamant the hiſſing Steel.* Canto II. l. 191.

AS iron is formed near the ſurface of the earth, it becomes expoſed to ſtreams of water and of air more than moſt other metallic bodies, and thence becomes combined with oxygene, or vital air, and appears very frequently in its calciform ſtate, as in variety of ochres. Manganeſe and zinc, and ſometimes lead, are alſo found near the ſurface of the earth, and, on that account, become combined with vital air, and are exhibited in their calciform ſtate.

The avidity with which iron unites with oxygene, or vital air, in which proceſs much heat is given out from the combining materials, is ſhewn by a curious experiment of M. Ingenhouz. A fine iron wire, twiſted ſpirally, is fixed to a cork, on the point of the ſpire is fixed a match made of agaric, dipped in ſolution of nitre; the match is then ignited, and the wire with the cork put immediately into a bottle full of vital air, the match firſt burns vividly, and the iron ſoon takes fire, and conſumes with brilliant ſparks till it is reduced to ſmall brittle globules, gaining an addition of about one third of its weight by its union with vital air. Annales de Chimie. Traité de Chimie, par Lavoiſier, c. iii.

## STEEL.

It is probably owing to a total deprivation of vital air, which it holds with ſo great avidity, that iron, on being kept many hours or days in ignited charcoal, becomes converted into ſteel, and thence acquires the faculty of being welded, when red hot, long before it melts, and alſo the power of becoming hard when immerſed in cold water; both which I ſuppoſe depend on the ſame cauſe, that is, on its being a worſe conductor of heat than other metals; and hence the ſurface both acquires heat much ſooner, and loſes it much ſooner, than the internal parts of it, in this circumſtance reſembling glaſs.

When ſteel is made very hot, and ſuddenly immerged in very cold water, and moved about in it, the ſurface of the ſteel becomes cooled firſt, and thus producing a kind of caſe or arch over the internal part, prevents that internal part from contracting quite ſo much as it otherwiſe would do, whence it becomes brittler and harder, like the glaſs drops called Prince Rupert's drops, which are made by dropping melted glaſs into cold water. This idea is countenanced by the circumſtance that hardened ſteel is ſpecifically lighter than ſteel which is more gradually cooled. (Nicholſon's Chemiſtry, p. 313.) Why the brittleneſs and hardneſs of ſteel or glaſs ſhould keep pace, or be companions to each other, may be difficult to conceive.

When a ſteel ſpring is forcibly bent till it break, it requires leſs power to bend it through the firſt inch than the ſecond, and leſs through the ſecond than the third. The ſame I ſuppoſe to happen if a wire be diſtended till it break, by hanging weights to it. This ſhews that the particles may be forced from each other, to a ſmall diſtance, by leſs power than is neceſſary to make them recede to a greater diſtance; in this circumſtance, perhaps, the attraction of coheſion differs from that of gravitation, which exerts its power inverſely as the ſquares of the diſtance. Hence it appears, that if the innermoſt particles of a ſteel bar, by cooling the external ſurface firſt, are kept from approaching each other ſo nearly as they otherwiſe would do, that they become in the ſituation of the particles on the convex ſide of a bent ſpring, and cannot be forced farther from each other except by a greater power than would have been neceſſary to have made them recede thus far. And, ſecondly, that if they be forced a little farther from each other they ſeparate: this may be exemplified by laying two magnetic needles parallel to each other, the contrary poles together, then drawing them longitudinally from each other, they will ſlide with ſmall force till they begin to ſeparate, and will then require a ſtronger force to really ſeparate them. Hence it appears, that hardneſs and brittleneſs depend on the ſame circumſtance, that the particles are removed to a greater diſtance from each other, and thus reſiſt any power more forcibly which is applied to diſplace them farther; this conſtitutes hardneſs. And, ſecondly, if they are diſplaced by ſuch applied force, they immediately ſeparate, and this conſtitutes brittleneſs.

Steel may be thus rendered too brittle for many purpoſes, on which account artiſts have means of ſoftening it again, by expoſing it to certain degrees of heat, for the conſtruction of different kinds of tools, which is called tempering it. Some artiſts plunge large tools in very cold water as ſoon as they are completely ignited, and moving them about, take them out as ſoon as they ceaſe to be luminous beneath the water; they are then rubbed quickly with a file, or on ſand, to clean the ſurface; the heat which the metal ſtill retains ſoon begins to produce a ſucceſſion of colours; if a hard temper be required, the piece is dipped again, and ſtirred about in cold water as ſoon as the yellow tinge appears; if it be cooled when the purple tinge appears, it becomes fit for gravers' tools, uſed in working upon metals; if cooled while blue, it is proper for ſprings. Nicholſon's Chemiſtry, p. 313. Keir's Chemical Dictionary.

## MODERN PRODUCTION OF IRON.

The recent production of iron is evinced from the chalybeate waters which flow from moraſſes, which lie upon gravel-beds, and which muſt, therefore, have produced iron after thoſe gravel-beds were raiſed out of the ſea. On the ſouth ſide of the road between Cheadle and Okeymoor, in Staffordſhire, yellow ſtains of iron are ſeen to penetrate the gravel from a thin moraſs on its ſurface. There is a fiſſure eight or ten feet wide, in a gravel-bed on the eaſtern ſide of the hollow road, aſcending the hill about a mile from Trentham, in Staffordſhire, leading toward Drayton, in Shropſhire, which fiſſure is filled up with nodules of iron-ore. A bank of ſods is now raiſed againſt this fiſſure to prevent the looſe iron nodules from falling into the turnpike road, and thus this natural curioſity is at preſent concealed from travellers. A ſimilar fiſſure, in a bed of marl, and filled up with iron nodules, and with ſome large pieces of flint, is ſeen on the eaſtern ſide of the hollow road aſcending the hill from the turnpike houſe, about a mile from Derby, in the road towards Burton. And another ſuch fiſſure, filled with iron nodes, appears about half a mile from Newton-Solney, in Derbyſhire, in the road to Burton, near the ſummit of the hill. Theſe collections of iron and of flint muſt have been produced poſterior to the elevation of all thoſe hills, and were thence evidently of vegetable or animal origin. To which ſhould be added, that iron is found, in general, in beds either near the ſurface of the earth, or ſtratified with clay, coals, or argillaceous grit, which are themſelves productions of the modern world, that is, from the recrements of vegetables and air-breathing animals.

Not only iron, but manganeſe, calamy, and even copper and lead, appear, in ſome inſtances, to have been of recent production. Iron and manganeſe are detected in all vegetable productions, and it is probable other metallic bodies might be found to exiſt in vegetable or animal matters, if we had teſts to detect them in very minute quantities. Manganeſe and calamy are found in beds like iron near the ſurface of the earth, and in a calciform ſtate, which countenances their modern production. The recent production of calamy, one of the ores of zinc, appears from its frequently incruſting calcareous ſpar, in its deſcent from the ſurface of the earth into the uppermoſt fiſſures of the lime-ſtone mountains of Derbyſhire. That the calamy has been carried, by its ſolution or diffuſion in water, into theſe cavities, and not by its aſcent from below in form of ſteam, is evinced from its not only forming a cruſt over the dogtooth ſpar, but by its afterwards diſſolving or deſtroying the ſparry cryſtal. I have ſpecimens of calamy in the form of dogtooth ſpar two inches high, which are hollow, and ſtand half an inch above the diminiſhed ſparry cryſtal on which they were formed, like a ſheath a great deal too big for it; this ſeems to ſhew, that this proceſs was carried on in water, otherwiſe, after the calamy had incruſted its ſpar, and diſſolved its ſurface, ſo as to form a hollow cavern over it, it could not act further upon it except by the interpoſition of ſome medium. As theſe ſpars and calamy are formed in the fiſſures of mountains, they muſt both have been formed after the elevations of thoſe mountains.

In reſpect to the recent production of copper, it was before obſerved, in note on Canto II. l. 398, that the ſummit of the grit-ſtone mountain at Hawkſtone, in Shropſhire, is tinged with copper, which, from the appearance of the blue ſtains, ſeems to have deſcended to the parts of the rock beneath. I have a calciform ore of copper conſiſting of the hollow cruſts of cubic cells, which has evidently been formed on cryſtals of fluor, which it has eroded in the ſame manner as the calamy erodes the calcareous cryſtals, from whence may be deduced, in the ſame manner, the aqueous ſolution or diffuſion, as well as the recent production of this calciform ore of copper.

Lead, in ſmall quantities, is ſometimes found in the fiſſures of coal-beds, which fiſſures are previouſly covered with ſpar; and ſometimes in nodules of iron-ore. Of the former I have a ſpecimen from near Caulk, in Derbyſhire, and of the latter from Colebrook Dale, in Shropſhire. Though all theſe facts ſhew that ſome metallic bodies are formed from vegetable or animal recrements, as iron, and perhaps manganeſe and calamy, all which are found near the ſurface of the earth; yet as the other metals are found only in fiſſures of rocks, which penetrate to unknown depths, they may be wholly or in part produced by aſcending ſteams from ſubterraneous fires, as mentioned in note on Canto II. l. 398.

## SEPTARIA OF IRON-STONE.

Over ſome lime works at Walſall, in Staffordſhire, I obſerved ſome years ago a ſtratum of iron earth about ſix inches thick, full of very large cavities; theſe cavities were evidently produced when the material paſſed from a ſemi-fluid ſtate into a ſolid one; as the frit of the potters, or a mixture of clay and water, is liable to crack in drying; which is owing to the further contraction of the internal part, after the cruſt has become hard. Theſe hollows are liable to receive extraneous matter, as, I believe, gypſum, and ſometimes ſpar, and even lead; a curious ſpecimen of the laſt was preſented to me by Mr. Darby, of Colebrook Dale, which contains in its cavity ſome ounces of lead-ore. But there are other ſeptaria of iron-ſtone, which ſeem to have had a very different origin, their cavities having been formed in cooling or congealing from an ignited ſtate, as is ingeniouſly deduced by Dr. Hutton, from their internal ſtructure. Edinb. Tranſ. vol. I. p. 246. The volcanic origin of theſe curious ſeptaria, appears to me to be further evinced from their form and the places where they are found. They conſiſt of oblate ſpheroids, and are found in many parts of the earth totally detached from the beds in which they lie, as at Eaſt-Lothian, in Scotland. Two of theſe, which now lie before me, were found, with many others, immerſed in argillaceous ſhale, or ſhiver, ſurrounded by broken lime-ſtone mountains, at Bradbourn, near Aſhbourn, in Derbyſhire, and were preſented to me by Mr. Buxton, a gentleman of that town. One of theſe is about fifteen inches in its equatorial diameter, and about ſix inches in its polar one, and contains beautiful ſtarlike ſeptaria, incruſted, and in part filled with calcareous ſpar. The other is about eight inches in its equatorial diameter, and about four inches in its polar diameter, and is quite ſolid, but ſhews on its internal ſurface marks of different colours, as if a beginning ſeparation had taken place. Now, as theſe ſeptaria contain fifty per cent. of iron, according to Dr. Hutton, they would ſoften or melt into a ſemi-fluid globule, by ſubterraneous fire, by leſs heat than the lime-ſtone in their vicinity; and if they were ejected through a hole or fiſſure, would gain a circular motion along with their progreſſive one, by their greater friction or adheſion to one ſide of the hole. This whirling motion would produce the oblate ſpheroidical form which they poſſeſs, and which, as far as I know, can not in any other way be accounted for. They would then harden in the air as they roſe into the colder parts of the atmoſphere; and as they deſcended into ſo ſoft a material as ſhale or ſhiver, their forms would not be injured in their fall; and their preſence in materials ſo different from themſelves becomes accounted for.

About the tropics of the large ſeptarium above-mentioned, are circular eminent lines, ſuch as might have been left if it had been coarſely turned in a lath. Theſe lines ſeem to conſiſt of fluid matter, which ſeems to have exſuded in circular zones, as their edges appear blunted or retracted; and the ſeptarium ſeems to have ſplit eaſier in ſuch ſections parrallel to its equator. Now, as the cruſt would firſt begin to cool and harden after its ejection in a ſemi-fluid ſtate, and the equatorial diameter would become gradually enlarged as it roſe in the air; the internal parts, being ſofter, would ſlide beneath the polar cruſt, which might crack, and permit part of the ſemi-fluid to exſude, and it is probable the adheſion would thus become leſs in ſections parallel to the equator. Which further confirms this idea of the production of theſe curious ſeptaria. A new-caſt cannon ball, red-hot, with its cruſt only ſolid, if it were ſhot into the air, would probably burſt in its paſſage, as it would conſiſt of a more fluid material than theſe ſeptaria; and thus, by diſcharging a ſhower of liquid iron, would produce more dreadful combuſtion, if uſed in war, than could be effected by a ball which had been cooled and was heated again, ſince, in the latter caſe, the ball could not have its internal parts made hotter than the cruſt of it, without firſt loſing its form.

## NOTE XIX.—FLINT.

*Tranſmute to glittering Flints her chalky lands,*
*Or ſink on Ocean's bed in countleſs Sands.* Canto II. l. 217.

### 1. SILICEOUS ROCKS.

THE great maſſes of ſiliceous ſand which lie in rocks upon the beds of lime-ſtone, or which are ſtratified with clay, coal, and iron-ore, are evidently produced in the decompoſition of vegetable or animal matters, as explained in the note on moraſſes. Hence the impreſſions of vegetable roots and even whole trees are often found in ſand-ſtone, as well as in coals and iron-ore. In theſe ſand-rocks both the ſiliceous acid and the calcareous baſe ſeem to be produced from the materials of the moraſs; for though the preſence of a ſiliceous acid and of a calcareous baſe have not yet been ſeparately exhibited from flints, yet from the analogy of flint to fluor, and gypſum, and marble, and from the converſion of the latter into flint, there can be little doubt of their exiſtence.

Theſe ſiliceous ſand-rocks are either held together by a ſiliceous cement, or have a greater or leſs portion of clay in them, which in ſome acts as a cement to the ſiliceous cryſtals, but in others is in ſuch great abundance that in burning them they become an imperfect porcelain, and are then uſed to repair the roads, as at Cheſterfield, in Derbyſhire; theſe are called argillaceous grit by Mr. Kirwan. In other places, a calcareous matter cements the cryſtals together; and in other places the ſiliceous cryſtals lie in looſe ſtrata, under the marl, in the form of white ſand; as at Normington, about a mile from Derby.

The loweſt beds of ſiliceous ſand-ſtone, produced from moraſſes, ſeem to obtain their acid from the moraſs, and their calcareous baſe from the lime-ſtone on which it reſts. Theſe beds poſſeſs a ſiliceous cement, and from their greater purity and hardneſs are uſed for coarſe grinding-ſtones and ſcythe ſtones, and are ſituated on the edges of lime-ſtone countries, having loſt the other ſtrata of coals, or clay, or iron, which were originally produced above them. Such are the ſand-rocks incumbent on lime-ſtone near Matlock, in Derbyſhire. As theſe ſiliceous ſand-rocks contain no marine productions ſcattered amongſt them, they appear to have been elevated, torn to pieces, and many fragments of them ſcattered over the adjacent country, by exploſions, from fires within the moraſs from which they have been formed, and which diſſipated every thing inflammable above and beneath them, except ſome ſtains of iron with which they are in ſome places ſpotted. If theſe ſand-rocks had been accumulated beneath the ſea, and elevated along with the beds of lime-ſtone on which they reſt, ſome veſtiges of marine ſhells, either in their ſiliceous or calcareous ſtate, muſt have been diſcerned amongſt them.

## 2. SILICEOUS TREES.

In many of theſe ſand-rocks are found the impreſſions of vegetable roots, which ſeem to have been the moſt unchangeable parts of the plant, as ſhells and ſhark's teeth are found in chalk beds, from their being the moſt unchangeable parts of the animal. In other inſtances the wood itſelf is penetrated, and whole trees converted into flint; ſpecimens of which I have by me, from near Coventry, and from a gravel-pit in Shropſhire, near Child's Archal, in the road to Drayton. Other poliſhed ſpecimens of vegetable flints abound in the cabinets of the curious, which evidently ſhew the concentric circles of woody fibres, and their interſtices filled with whiter ſiliceous matter, with the branching off of the knots when cut horizontally, and the parallel lines of wood when cut longitudinally, with uncommon beauty and variety. Of theſe I poſſeſs ſome beautiful ſpecimens, which were preſented to me by the Earl of Uxbridge.

The colours of theſe ſiliceous vegetables are generally brown, from the iron, I ſuppoſe, or mangeneſe, which induced them to cryſtalize or to fuſe more eaſily. Some of the cracks of the wood in drying are filled with white flint or calcedony, and others of them remain hollow, lined with innumerable ſmall cryſtals, tinged with iron, which I ſuppoſe had a ſhare in converting their calcareous matter into ſiliceous cryſtals, becauſe the cryſtals called Peak-diamonds are always found bedded in an ochreous earth; and thoſe called Briſtol-ſtones are ſituated on lime-ſtone coloured with iron. Mr. F. French preſented me with a congeries of ſiliceous cryſtals, which he gathered on the crater (as he ſuppoſes) of an extinguiſhed volcano at Cromach Water, in Cumberland. The cryſtals are about an inch high, in the ſhape of dogtooth or calcareous ſpar, covered with a dark ferruginous matter. The bed on which they reſt is about an inch in thickneſs, and is ſtained with iron on its under ſurface. This curious foſſil ſhews the tranſmutation of calcareous earth into ſiliceous, as much as the ſiliceous ſhells which abound in the cabinets of the curious. There may ſome time be diſcovered in this age of ſcience, a method of thus impregnating wood with liquid flint, which would produce pillars for the ſupport, and tiles for the covering of houſes, which would be uninflammable and endure as long as the earth beneath them.

That ſome ſiliceous productions have been in a fluid ſtate without much heat at the time of their formation, appears from the vegetable flints above deſcribed not having quite loſt their organized appearance; from ſhells, and coralloids, and entrochi being converted into flint without loſing their form; from the baſon of calcedony round Gieſar, in Iceland, and from the experiment of Mr. Bergman, who obtained thirteen regular formed cryſtals by ſuffering the powder of quartz to remain in a veſſel with fluor acid for two years; theſe cryſtals were about the ſize of ſmall peas, and were not ſo hard as quartz. Opuſc. de Terrâ Siliceâ, p. 33. Mr. Achard procured both calcareous and ſiliceous cryſtals, one from calcareous earth, and the other from the earth of alum, both diſſolved in water impregnated with fixed air; the water filtrating very ſlowly through a porous bottom of baked clay. See Journal de Phyſique, for January, 1778.

### 3. AGATES, ONYXES, SCOTS-PEBBLES.

In ſmall cavities of theſe ſand-rocks, I am informed, the beautiful ſiliceous nodules are found which are called Scots-pebbles; and which, on being cut in different directions, take the names of agates, onyxes, ſardonyxes, &c. according to the colours of the lines or ſtrata which they exhibit. Some of the nodules are hollow and filled with cryſtals, others have a nucleus of leſs compact ſiliceous matter, which is generally white, ſurrounded with many concentric ſtrata, coloured with iron, and other alternate ſtrata of white agate or calcedony, ſometimes to the number of thirty.

I think theſe nodules bear evident marks of their having been in perfect fuſion by either heat alone, or by water and heat, under great preſſure, according to the ingenious theory of Dr. Hutton; but I do not imagine, that they were injected into cavities from materials from without, but that ſome vegetables or parts of vegetables containing more iron or manganeſe than others, facilitated the complete fuſion, thus deſtroying the veſtiges of vegetable organization, which were conſpicuous in the ſiliceous trees above-mentioned. Some of theſe nodules being hollow and lined with cryſtals, and others containing a nucleus of white ſiliceous matter of a looſer texture, ſhew they were compoſed of the materials then exiſting in the cavity; which conſiſting before of looſe ſand, muſt take up leſs ſpace when fuſed into a ſolid maſs.

Theſe ſiliceous nodules reſemble the nodules of iron-ſtone mentioned in note on Canto II. l. 183, in reſpect to their poſſeſſing a great number of concentric ſpheres, coloured generally with iron; but they differ in this circumſtance, that the concentric ſpheres generally obey the form of the external cruſt, and in their not poſſeſſing a chalybeate nucleus. The ſtalactites formed on the roofs of caverns are often coloured in concentric ſtrata, by their coats being ſpread over each other at different times; and ſome of them, as the cupreous ones, poſſeſs great beauty from this formation; but as theſe are neceſſarily more or leſs of a cylindrical or conic form, the nodules or globular flints above deſcribed cannot have been conſtructed in this manner. To what law of nature then is to be referred the production of ſuch numerous concentric ſpheres? I ſuſpect to the law of congelation.

When ſalt and water are expoſed to ſevere froſty air, the ſalt is ſaid to be precipitated as the water freezes; that is, as the heat in which it was diſſolved is withdrawn: where the experiment is tried in a bowl or baſon, this may be true, as the ſurface freezes firſt, and the ſalt is found at the bottom. But in a fluid expoſed in a thin phial, I found, by experiment, that the extraneous matter previouſly diſſolved by the heat, in the mixture, was not ſimply ſet at liberty to ſubſide, but was detruded or puſhed backward as the ice was produced. The experiment was this: about two ounces of a ſolution of blue vitriol were accidentally frozen in a thin phial, the glaſs was cracked and fallen to pieces, the ice was diſſolved, and I found a pillar of blue vitriol ſtanding erect on the bottom of the broken bottle. Nor is this power of congelation more extraordinary than that, by its powerful and ſudden expanſion, it ſhould burſt iron ſhells and coehorns, or throw out the plugs with which the water was ſecured in them, above one hundred and thirty yards, according to the experiments at Quebec, by Major Williams. Edinb. Tranſact. vol. II. p. 23.

In ſome ſiliceous nodules, which now lie before me, the external cruſt for about the tenth of an inch conſiſts of white agate, in others it is much thinner, and in ſome much thicker; correſponding with this cruſt there are from twenty to thirty ſuperincumbent ſtrata, of alternately darker and lighter colour; whence it appears, that the external cruſt, as it cooled or froze, propelled from it the iron or mangaueſe which was diſſolved in it; this receded till it had formed an arch or vault ſtrong enough to reſiſt its further protruſion; then the next inner ſphere or ſtratum, as it cooled or froze, propelled forwards its colouring matter in the ſame manner, till another arch or ſphere produced ſufficient reſiſtance to this frigoreſcent expulſion. Some of them have detruded their colouring matter quite to the centre, the rings continuing to become darker as they are nearer it; in others the chalybeate arch ſeems to have ſtopped half an inch from the centre, and become thicker by having attracted to itſelf the irony matter from the white nucleus, owing probably to its cooling leſs precipitately in the central parts than at the ſurface of the pebble.

A ſimilar detruſion of a marly matter, in circular arches or vaults, obtains in the ſalt mines in Cheſhire; from whence Dr. Hutton very ingeniouſly concludes, that the ſalt muſt have been liquified by heat, which would ſeem to be much confirmed by the above theory. Edinb. Tranſ. vol. I. p. 244.

I cannot conclude this account of Scots-pebbles without obſerving, that ſome of them, on being ſawed longitudinally aſunder, ſeem ſtill to poſſeſs ſome veſtiges of the cylindrical organization of vegetables; others poſſeſs a nucleus of white agate, much reſembling ſome bulbous roots, with their concentric coats, or the knots in elm-roots or crab-trees; ſome of theſe, I ſuppoſe, were formed in the manner above explained, during the congelation of maſſes of melted flint and iron; others may have been formed from a vegetable nucleus, and retain ſome veſtiges of the organization of the plant.

## 4. SAND OF THE SEA.

The great abundance of ſiliceous ſand at the bottom of the ocean may, in part, be waſhed down from the ſiliceous rocks above deſcribed; but, in general, I ſuppoſe it derives its acid only from the vegetable and animal matter of moraſſes, which is carried down by floods or by the atmoſphere, and becomes united in the ſea with its calcareous baſe, from ſhells and coralloids, and thus aſſumes its cryſtalline form at the bottom of the ocean, and is there intermixed with gravel, or other matters, waſhed from the mountains in its vicinity.

## 5. CHERT, OR PETROSILEX.

The rocks of marble are often alternately intermixed with ſtrata of chert, or coarſe flint, and this in beds from one to three feet thick, as at Ilam and Matlock, or of leſs than the tenth of an inch in thickneſs, as a mile or two from Bakewell, in the road to Buxton. It is difficult to conceive in what manner ten or twenty ſtrata of either lime-ſtone or flint, of different ſhades of white and black, could be laid quite regularly over each other from ſediments, or precipitations from the ſea; it appears to me much eaſier to comprehend, by ſuppoſing, with Dr. Hutton, that both the ſolid rocks of marble and the flint had been fuſed by great heat (or by heat and water), under immenſe preſſure; by its cooling, or congealing, the colouring matter might be detruded, and form parallel or curvilinear ſtrata, as above explained.

The colouring matter, both of lime-ſtone and flint, was probably owing to the fleſh of peculiar animals, as well as the ſiliceous acid, which converted ſome of the lime-ſtone into flint; or to ſome ſtrata of ſhell-fiſh having been overwhelmed, when alive, with new materials, while others, dying in their natural ſituations, would loſe their fleſhy part, either by its putrid ſolution in the water, or by its being eaten by other ſea inſects. I have ſome calcareous foſſil ſhells which contain a black coaly matter in them, which was evidently the body of the animal, and others of the ſame kind filled with ſpar inſtead of it. The Labradore ſtone has, I ſuppoſe, its colours from the nacre, or mother-pearl ſhells, from which it was probably produced. And there is a ſtratum of calcareous matter about ſix or eight inches thick, at Wingerworth, in Derbyſhire, over the iron-beds, which is replete with ſhells of freſh-water muſcles, and evidently obtains its dark colour from them, as mentioned in note XVI. Many nodules of flint reſemble, in colour, as well in form, the ſhells of the echinus, or ſea-urchin; others reſemble ſome coralloids, both in form and colour; and M. Arduini found in the Monte de Pancraſio, red flints branching like corals, from whence they ſeem to have obtained both their form and their colour. Ferber's Travels in Italy, p. 42.

## 6. NODULES OF FLINT IN OHALK-BEDS.

As the nodules of flint found in chalk-beds poſſeſs no marks of having been rounded by attrition or ſolution, I conclude that they have gained their form, as well as their dark colour, from the fleſh of the ſhell-fiſh from which they had their origin; but which have been ſo completely fuſed by heat, or heat and water, as to obliterate all veſtiges of the ſhell, in the ſame manner as the nodules of agate and onyx were produced from parts of vegetables, but which had been ſo completely fuſed as to obliterate all marks of their organization, or as many iron-nodules have obtained their form and origin from peculiar vegetables.

Some nodules in chalk-beds conſiſt of ſhells of echini filled up with chalk, the animal having been diſſolved away by putreſcence in water, or eaten by other ſea inſects; other ſhells of echini, in which I ſuppoſe the animal's body remained, are converted into flint, but ſtill retain the form of the ſhell. Others, I ſuppoſe, as above, being more completely fuſed, have become flint-coloured by the animal fleſh, but without the exact form either of the fleſh or ſhell of the animal. Many of theſe are hollow within, and lined with cryſtals, like the Scots-pebbles above deſcribed; but as the colouring matter of animal bodies differs little from each other compared with thoſe of vegetables, theſe flints vary leſs in their colours than thoſe above-mentioned. At the ſame time as they cooled in concentric ſpheres, like the Scots-pebbles, they often poſſeſs faint rings of colours, and always break in conchoide forms like them.

This idea of the productions of nodules of flint in chalk-beds, is countenanced from the iron which generally appears as theſe flints become decompoſed by the air, which, by uniting with the iron in their compoſition, reduces it from a vitreſcent ſtate to that of calx, and thus renders it viſible. And, ſecondly, by there being no appearance in chalk-beds of a ſtring or pipe of ſiliceous matter connecting one nodule with another, which muſt have happened if the ſiliceous matter, or its acid, had been injected from without, according to the idea of Dr. Hutton. And, thirdly, becauſe many of them have very large cavities at their centres, which ſhould not have happened had they been formed by the injection of a material from without.

When ſhells or chalk are thus converted from calcareous to ſiliceous matter by the fleſh of the animal, the new flint being heavier than the ſhell or chalk, occupies leſs ſpace than the materials it was produced from; this is the cauſe of frequent cavities within them, where the whole maſs has not been completely fuſed and preſſed together. In Derbyſhire there are maſſes of coralloid and other ſhells which have become ſiliceous, and are thus left with large vacuities, ſometimes within and ſometimes on the outſide of the remaining form of the ſhell, like the French mill-ſtones, and, I ſuppoſe, might ſerve the ſame purpoſe; the gravel of the Derwent is full of ſpecimens of this kind.

Since writing the above, I have received a very ingenious account of chalk-beds from Dr. Meniſh, of Chelmsford. He diſtinguiſhes chalk-beds into three kinds; ſuch as have been raiſed from the ſea with little diſturbance of their ſtrata, as the cliffs of Dover and Margate, which he terms *intire* chalk. Another ſtate of chalk is where it has ſuffered much derangement, as the banks of the Thames at Graveſend and Dartford. And a third ſtate, where fragments of chalk have been rounded by water, which he terms *alluvial* chalk. In the firſt of theſe ſituations of chalk he obſerves, that the flint lies in ſtrata horizontally, generally in diſtinct nodules, but that he has obſerved two inſtances of ſolid plates or ſtrata of flint, from an inch to two inches in thickneſs, interpoſed between the chalk-beds; one of theſe is in a chalk-bank by the road ſide, at Berkhamſtead, the other in a bank on the road from Chatham leading to Canterbury. Dr. Meniſh has further obſerved, that many of the echini are cruſhed in their form, and yet filled with flint, which has taken the form of the cruſhed ſhell, and that though many flint nodules are hollow, yet that in ſome echini the ſiliceum ſeems to have enlarged as it paſſed from a fluid to a ſolid ſtate, as it ſwells out in a protuberance at the mouth and anus of the ſhell, and that though theſe ſhells are ſo filled with flint, yet that in many places the ſhell itſelf remains calcareous. Theſe ſtrata of nodules and plates of flint ſeem to countenance their origin from the fleſh of a ſtratum of animals which periſhed by ſome natural violence, and were buried in their ſhells.

## 7. ANGLES OF SILICEOUS SAND.

In many rocks of ſiliceous ſand the particles retain their angular form, and in ſome beds of looſe ſand, of which there is one of conſiderable purity a few yards beneath the marl at Normington, about a mile ſouth of Derby. Other ſiliceous ſands have had their angles rounded off, like the pebbles in gravel-beds. Theſe ſeem to owe their globular form to two cauſes; one to their attrition againſt each other, when they may for centuries have lain at the bottom of the ſea, or of rivers, where they may have been progreſſively accumulated, and thus progreſſively at the ſame time rubbed upon each other by the daſhing of the water, and where they would be more eaſily rolled over each other by their gravity being ſo much leſs than in air. This is evidently now going on in the river Derwent; for though there are no lime-ſtone rocks for ten or fifteen miles above Derby, yet a great part of the river-gravel at Derby conſiſts of lime-ſtone nodules, whoſe angles are quite worn off in their deſcent down the ſtream.

There is, however, another cauſe which muſt have contributed to round the angles both of calcareous and ſiliceous fragments, and that is, their ſolubility in water; calcareous earth is perpetually found ſuſpended in the waters which paſs over it; and the earth of flints was obſerved by Bergman to be contained in water in the proportion of one grain to a gallon. Kirwan's Mineralogy, p. 107. In boiling water, however, it is ſoluble in much greater proportion, as appears from the ſiliceous earth ſublimed in the diſtillation of fluor acid in glaſs veſſels, and from the baſons of calcedony which ſurrounded the jets of hot water near Mount Hecla, in Iceland. Troil on Iceland. It is probable moſt ſiliceous ſands or pebbles have, at ſome ages of the world, been long expoſed to aqueous ſteams raiſed by ſubterranean fires. And if fragments of ſtone were long immerſed in a fluid menſtruum, their angular parts would be firſt diſſolved, on account of their greater ſurface.

Many beds of ſiliceous gravel are cemented together by a ſiliceous cement, and are called breccia, as the plumb-pudding ſtones of Hartfordſhire, and the walls of a ſubterraneous temple excavated by Mr. Curzon, at Hagley, near Rugely, in Staffordſhire; theſe may have been expoſed to great heat as they were immerſed in water, which water, under great preſſure of ſuperincumbent materials, may have been rendered red-hot, as in Papin's digeſter; and have thus poſſeſſed powers of ſolution with which we are unacquainted.

## BASALTES AND GRANITES.

Another ſource of ſiliceous ſtones is from the granite, or baſaltes, or porphyries, which are of different hardneſſes, according to the materials of their compoſition, or to the fire they have undergone; ſuch are the ſtones of Arthur's-hill, near Edinburgh; of the Giant's Cauſeway, in Ireland; and of Charnwood Foreſt, in Leiceſterſhire; the uppermoſt ſtratum of which laſt ſeems to have been cracked either by its elevation, or by its haſtily cooling, after ignition, by the contact of dews or ſnows, and thus breaks into angular fragments, ſuch as the ſtreets of London are paved with, or have had their angles rounded by attrition, or by partial ſolution; and have thus formed the common paving ſtones, or bowlers, as well as the gravel, which is often rolled into ſtrata amid the ſiliceous ſand-beds, which are either formed or collected in the ſea.

In what manner ſuch a maſs of cryſtallized matter as the Giant's Cauſeway, and ſimilar columns of baſaltes, could have been raiſed without other volcanic appearances, may be a matter not eaſy to comprehend; but there is another power in nature beſides that of expanſile vapour, which may have raiſed ſome materials which have previouſly been in igneous or aqueous ſolution; and that is the act of congelation. When the water, in the experiments above related of Major Williams, had, by congelation, thrown out the plugs from the bomb-ſhells, a column of ice roſe from the hole of the bomb ſix or eight inches high. Other bodies, I ſuſpect, increaſe in bulk, which cryſtallize in cooling, as iron and type-metal. I remember pouring eight or ten pounds of melted brimſtone into a pot to cool, and was ſurprized to ſee, after a little time, a part of the fluid beneath break a hole in the congealed cruſt above it, and gradually riſe into a promontory ſeveral inches high; the baſaltes has many marks of fuſion and of cryſtallization, and may thence, as well as many other kinds of rock, as of ſpar, marble, petroſilex, jaſper, &c. have been raiſed by the power of congelation, a power whoſe quantity has not yet been aſcertained, and, perhaps, greater and more univerſal than that of vapours expanded by heat. Theſe baſaltic columns riſe ſometimes out of mountains of granite itſelf, as mentioned by Dr. Beddoes, (Phil. Tranſ. vol. LXXX.) and as they ſeem to conſiſt of ſimilar materials, more completely fuſed, there is ſtill greater reaſon to believe them to have been elevated in the cooling or cryſtallization of the maſs. See note XXIV.

## NOTE XX.—CLAY.

*Hence ductile Clays in wide expanſion ſpread,*
*Soft as the Cygnet's down, their ſnow-white bed.* CANTO II. l. 277.

THE philoſophers who have attended to the formation of the earth, have acknowledged two great agents in producing the various changes which the terraqueous globe has undergone, and theſe are water and fire. Some of them have, perhaps, aſcribed too much to one of theſe great agents of nature, and ſome to the other. They have generally agreed, that the ſtratification of materials could only be produced from ſediments or precipitations, which were previouſly mixed or diſſolved in the ſea; and that whatever effects were produced by fire, were performed afterwards.

There is, however, great difficulty in accounting for the univerſal ſtratification of the ſolid globe of the earth in this manner, ſince many of the materials, which appear in ſtrata, could not have been ſuſpended in water; as the nodules of flint in chalk-beds, the extenſive beds of ſhells; and, laſtly, the ſtrata of coal, clay, ſand, and iron-ore, which, in moſt coal-countries, lie from five to ſeven times alternately ſtratified over each other, and none of them are ſoluble in water. Add to this, if a ſolution of them, or a mixture of them in water, could be ſuppoſed, the cauſe of that ſolution muſt ceaſe before a precipitation could commence.

1. The great maſſes of lava, under the various names of granite, porphyry, toad-ſtone, moor-ſtone, rag, and ſlate, which conſtitute the old world, may have acquired the old ſtratification, which ſome of them appear to poſſeſs, by their having been formed by ſucceſſive eruptions of a fluid maſs, which, at different periods of ancient time, aroſe from volcanic ſhafts and covered each other, the ſurface of the interior maſs of lava would cool, and become ſolid, before the ſuperincumbent ſtratum was poured over it; to the ſame cauſe may be aſcribed their different compoſitions and textures, which are ſcarcely the ſame in any two parts of the world.

2. The ſtratifications of the great maſſes of lime-ſtone, which were produced from ſea-ſhells, ſeem to have been formed by the different times at which the innumerable ſhells were produced and depoſited. A colony of echini, or madrepores, or cornua ammonis, lived and periſhed in one period of time; in another, a new colony of either ſimilar or different ſhells lived and died over the former ones, producing a ſtratum of more recent ſhells over a ſtratum of others which had begun to petrify, or to become marble; and thus, from unknown depths to what are now the ſummits of mountains, the lime-ſtone is diſpoſed in ſtrata of varying ſolidity and colour. Theſe have afterwards undergone variety of changes by their ſolution and depoſition from the water in which they were immerſed, or from having been expoſed to great heat under great preſſure, according to the ingenious theory of Dr. Hutton. Edinb. Tranſact. vol. I. See Note XVI.

3. In moſt of the coal-countries of this iſland, there are from five to ſeven beds of coal ſtratified, with an equal number of beds, though of much greater

thickneſs, of clay and ſand-ſtone, and occaſionally of iron-ores. In what manner to account for the ſtratification of theſe materials ſeems to be a problem of great difficulty. Philoſophers have generally ſuppoſed that they have been arranged by the currents of the ſea; but conſidering their inſolubility in water, and their almoſt ſimilar ſpecific gravity, an accumulation of them in ſuch diſtinct beds from this cauſe is altogether inconceivable, though ſome coal-countries bear marks of having been, at ſome time, immerſed beneath the waves, and raiſed again by ſubterranean fires.

The higher and lower parts of moraſſes were neceſſarily produced at different periods of time, ſee Note XVII. and would thus originally be formed in ſtrata of different ages. For when an old wood periſhed, and produced a moraſs, many centuries would elapſe before another wood could grow, and periſh again, upon the ſame ground, which would thus produce a new ſtratum of moraſs over the other, differing, indeed, principally in its age, and, perhaps, as the timber might be different, in the proportion of its component parts.

Now, if we ſuppoſe the lowermoſt ſtratum of a moraſs become ignited, like fermenting hay (after whatever could be carried away by ſolution in water was gone), what would happen? Certainly the inflammable part, the oil, ſulphur, or bitumen, would burn away, and be evaporated in air; and the fixed parts would be left, as clay, lime, and iron; while ſome of the calcareous earth would join with the ſiliceous acid, and produce ſand; or with the argillaceous earth, and produce marl. Thence, after many centuries, another bed would take fire, but with leſs degree of ignition, and with a greater body of moraſs over it; what then would happen? The bitumen and ſulphur would riſe, and might become condenſed under an impervious ſtratum, which might not be ignited, and there form coal of different purities, according to its degree of fluidity, which would permit ſome of the clay to ſubſide through it into the place from which it was ſublimed.

Some centuries afterwards another ſimilar proceſs might take place, and either thicken the coal-bed, or produce a new clay-bed, or marl, or ſand, or depoſit iron upon it, according to the concomitant circumſtances abovementioned.

I do not mean to contend, that a few maſſes of ſome materials may not have been rolled together by currents, when the mountains were much more elevated than at preſent, and, in conſequence, the rivers broader and more rapid, and the ſtorms of rain and wind greater both in quantity and force. Some gravel-beds may have been thus waſhed from the mountains; and ſome white clay waſhed from moraſſes into valleys beneath them; and ſome ochres of iron diſſolved and again depoſited by water; and ſome calcareous depoſitions from water (as the bank, for inſtance, on which ſtand the houſes at Matlock-bath); but theſe are all of ſmall extent or conſequence compared to the primitive rocks of granite or porphyry which form the nucleus of the earth, or to the immenſe ſtrata of lime-ſtone which cruſt over the greateſt part of this granite or porphyry; or, laſtly, to the very extenſive beds of clay, marl, ſand-ſtone, coal, and iron, which were probably for many millions of years the only parts of our continents and iſlands, which were then elevated above the level of the ſea, and which, on that account, became covered with vegetation, and thence acquired their later or ſuperincumbent ſtrata, which conſtitute what ſome have termed the new world.

There is another ſource of clay, and that of the fineſt kind, from decompoſed granite; this is of a ſnowy white, and mixed with ſhining particles of mica; of this kind is an earth from the country of Cherokees. Other kinds are from leſs pure lavas; Mr. Ferber aſſerts that the ſulphurous ſteams from Mount Veſuvius convert the lava into clay.

"The lavas of the ancient Solfatara volcano have been undoubtedly of a vitreous nature, and theſe appear at preſent argillaceous. Some fragments of this lava are but half, or at one ſide changed into clay, which either is viſcid or ductile, or hard and ſtony. Clays, by fire, are deprived of their coherent quality, which cannot be reſtored to them by pulverization, nor by humectation. But the ſulphureous Solfatara ſteams reſtore it, as may be eaſily obſerved on the broken pots wherein they gather the ſal ammoniac; though very well baked and burnt at Naples, they are mollified again by the acid ſteams into a viſcid clay, which keeps the former fire-burnt colour." Travels in Italy, p. 156.

## NOTE XXI.—ENAMELS.

*Smear'd her huge dragons with metallic hues,*
*With golden purples, and cobaltic blues.* Canto II. l. 287.

THE fine bright purples or roſe colours which we ſee on china cups, are not producible with any other material except gold; mangancſe indeed gives a purple, but of a very different kind.

In Europe, the application of gold to theſe purpoſes, appears to be of modern invention. Caſſius's diſcovery of the precipitate of gold by tin, and the uſe of that precipitate for colouring glaſs and enamels, are now generally known; but though the precipitate with tin be more ſucceſsful in producing the ruby glaſs, or the colourleſs glaſs, which becomes red by ſubſequent ignition, the tin probably contributing to prevent the gold from ſeparating (which it is very liable to do during the fuſion); yet, for enamels, the precipitates made by alkaline ſalts anſwer equally well, and give a finer red; the colour produced by the tin precipitate being a bluiſh purple, but with the others a roſe red. I am informed that ſome of our beſt artiſts prefer aurum fulminans, mixing it, before it has become dry, with the white compoſition, or enamel flux; when once it is divided by the other matter, it is ground with great ſafety, and without the leaſt danger of exploſion, whether moiſt or dry. The colour is remarkably improved and brought forth by long grinding, which accordingly makes an eſſential circumſtance in the proceſs.

The precipitates of gold, and the colcothar, or other red preparations of iron, are called *tender* colours. The heat muſt be no greater than is juſt ſufficient to make the enamel run upon the piece, for if greater, the colours will be deſtroyed or changed to a different kind. When the vitreous matter has juſt become fluid, it ſeems as if the coloured metallic calx remained barely *intermixed* with it, like a coloured powder of exquiſite tenuity ſuſpended in water; but by ſtronger fire the calx is *diſſolved*, and metallic colours are altered by *ſolution* in glaſs, as well as in acids or alkalies.

The Saxon mines have, till very lately, almoſt excluſively ſupplied the reſt of Europe with cobalt, or rather with its preparations, zaffre and ſmalt, for the exportation of the ore itſelf is there a capital crime. Hungary, Spain, Sweden, and ſome other parts of the continent, are now ſaid to afford cobalts equal to the Saxon, and ſpecimens have been diſcovered in our own iſland, both in Cornwall and in Scotland, but hitherto in no great quantity.

Calces of cobalt and of copper differ very materially from thoſe above-mentioned in their application for colouring enamels. In thoſe the calx has previouſly acquired the intended colour, a colour which bears a red heat without injury, and all that remains is to fix it on the piece by a vitreous flux. But the blue colour of cobalt, and the green or bluiſh green of copper, are *produced* by vitrification, that is, by *ſolution* in the glaſs, and a ſtrong fire is neceſſary for their perfection. Theſe calces, therefore, when mixed with the enamel flux, are melted in crucibles, once or oftener, and the deep coloured opake glaſs, thence reſulting, is ground into impalpable powder, and uſed for enamel. One part of either of theſe calces is put to ten, ſixteen, or twenty parts of the flux, according to the depth of colour required. The heat of the enamel-kiln is only a full red, ſuch as is marked on Mr. Wedgwood's thermometer 6 degrees. It is therefore neceſſary that the flux be ſo adjuſted as to melt in that low heat. The uſual materials are flint, or flint-glaſs, with a due proportion of red-led, or borax, or both, and ſometimes a little tin calx to give opacity.

*Ka-o-lin* is the name given by the Chineſe to their porcelain clay, and *pe-tun-tſe* to the other ingredient in their China ware. Specimens of both theſe have been brought into England, and found to agree in quality with ſome of our own materials. Kaolin is the very ſame with the clay called in Cornwall and the petuntſe is a granite ſimilar to the Corniſh moor-ſtone. There are differences, both in the Chineſe petuntſes, and the Engliſh moor-ſtones; all of them contain micaceous and quartzy particles, in greater or leſs quantity, along with feltſpat, which laſt is the eſſential ingredient for the porcelain manufactory. The only injurious material commonly found in them is iron, which diſcolours the ware in porportion to its quantity, and which our moor-ſtones are, perhaps, more frequently tainted with than the Chineſe. Very fine porcelain has been made from Engliſh materials, but the nature of the manufacture renders the proceſs precarious and the profit hazardous; for the ſemi-vitrification, which conſtitutes porcelain, is neceſſarily accompanied with a degree of ſoftneſs or ſemi-fuſion, ſo that the veſſels are liable to have their forms altered in the kiln, or to run together with any accidental augmentations of the fire.

## NOTE XXII.—PORTLAND VASE.

*Or bid Mortality rejoice and mourn*
*O'er the fine forms on Portland's myſtic urn.* CANTO II. l. 319.

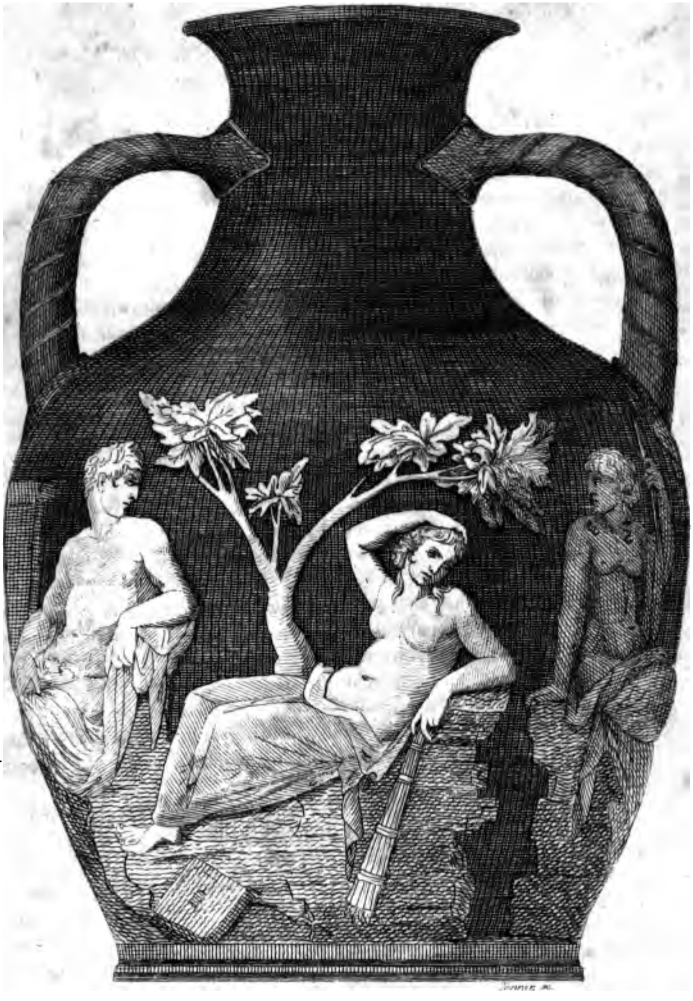
THE celebrated funeral vaſe, long in poſſeſſion of the Barberini family, and lately purchaſed by the Duke of Porland for a thouſand guineas, is about ten inches high, and ſix in diameter in the broadeſt part. The figures are of moſt exquiſite workmanſhip in bas relief, of white opake glaſs, raiſed on a ground of deep blue glaſs, which appears black, except when held againſt the light. Mr. Wedgwood is of opinion, from many circumſtances, that the figures have been made by cutting away the external cruſt of white opake glaſs, in the manner the fineſt cameos have been produced, and that it muſt thence have been the labour of a great many years. Some antiquarians have placed the time of its production many centuries before the chriſtian æra, as ſculpture was ſaid to have been declining, in reſpect to its excellence, in the time of Alexander the Great. See an account of the Barberini, or Portland vaſe, by M. D'Hancarville, and by Mr. Wedgwood.

Many opinions and conjectures have been publiſhed concerning the figures on this celebrated vaſe. Having carefully examined one of Mr. Wedgwood's beautiful copies of this wonderful production of art, I ſhall add one more conjecture to the number.

Mr. Wedgwood has well obſerved, that it does not ſeem probable that the Portland vaſe was purpoſely made for the aſhes of any particular perſon deceaſed, becauſe many years muſt have been neceſſary for its production. Hence it may be concluded, that the ſubject of its embelliſhments is not private hiſtory, but of a general nature. This ſubject appears to me to be well choſen, and the ſtory to be finely told; and that it repreſents what in ancient times engaged the attention of philoſophers, poets, and heroes; I mean a part of the Eleuſinian myſteries.

Theſe myſteries were invented in Egypt, and afterwards transferred to Greece, and flouriſhed more particularly at Athens, which was, at the ſame time, the ſeat of the fine arts. They conſiſted of ſcenical exhibitions, repreſenting and inculcating the expectation of a future life after death, and, on this account, were encouraged by the government, in ſo much that the Athenian laws puniſhed a diſcovery of their ſecrets with death. Dr. Warburton has, with great learning and ingenuity, ſhewn, that the deſcent of Æneas into hell, deſcribed in the ſixth Book of Virgil, is a poetical account of the repreſentations of the future ſtate in the Eleuſinian myſteries. Divine Legation, vol. I. p. 210.

And though ſome writers have differed in opinion from Dr. Warburton on this ſubject, becauſe Virgil has introduced ſome of his own heroes into the Elyſian fields, as Deiphobus, Palinurus, and Dido, in the ſame manner as Homer had done before him; yet it is agreed, that the received notions about a future ſtate were exhibited in theſe myſteries; and as theſe poets deſcribed thoſe received notions, they may be ſaid, as far as theſe religious doctrines were concerned, to have deſcribed the myſteries.



The Portland Vase.

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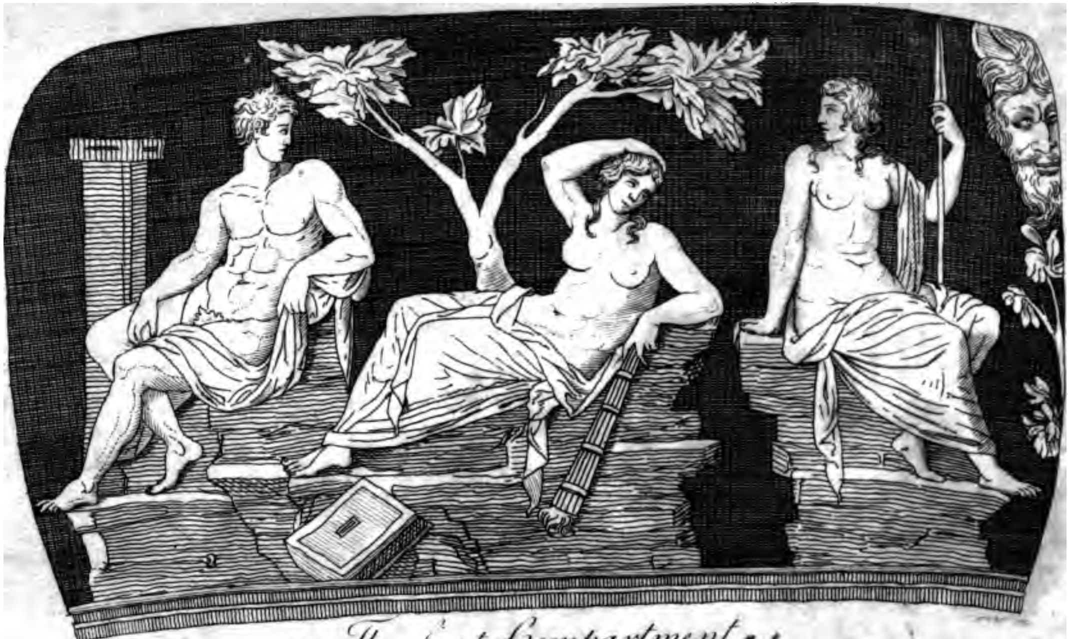


The first Compartment.

Now, as theſe were emblematic exhibitions, they muſt have been as well adapted to the purpoſes of ſculpture as of poetry, which, indeed, does not ſeem to have been uncommon, ſince one compartment of figures in the ſhield of Æneas repreſented the regions of Tartarus. Æn. Lib. X. The proceſſion of torches, which, according to M. De St. Croix, was exhibited in theſe myſteries, is ſtill to be ſeen in baſſo relievo, diſcovered by Spon and Wheler. Memoires ſur le Myſteres par De St. Croix. 1784. And it is very probable that the beautiful gem repreſenting the marriage of Cupid and Pſyche, as deſcribed by Apuleus, was originally deſcriptive of another part of the exhibitions in theſe myſteries, though afterwards it became a common ſubject of ancient art. See Divine Legat. vol. I. p. 323. What ſubject could have been imagined ſo ſublime for the ornaments of a funeral urn, as the mortality of all things, and their reſuſcitation? Where could the deſigner be ſupplied with emblems for this purpoſe, before the Chriſtian æra, but from the Eleuſinian myſteries?

1. The exhibitions of the myſteries were of two kinds—thoſe which the people were permitted to ſee, and thoſe which were only ſhewn to the initiated. Concerning the latter, Ariſtides calls them "the moſt ſhocking and moſt raviſhing repreſentations." And Stobœus aſſerts, that the initiation into the grand myſteries exactly reſembles death. Divine Legat. vol. I. p. 280, and p. 272. And Virgil, in his entrance to the ſhades below, amongſt other things of terrible form, mentions death. Æn. VI. This part of the exhibition ſeems to be repreſented in one of the compartments of the Portland vaſe.

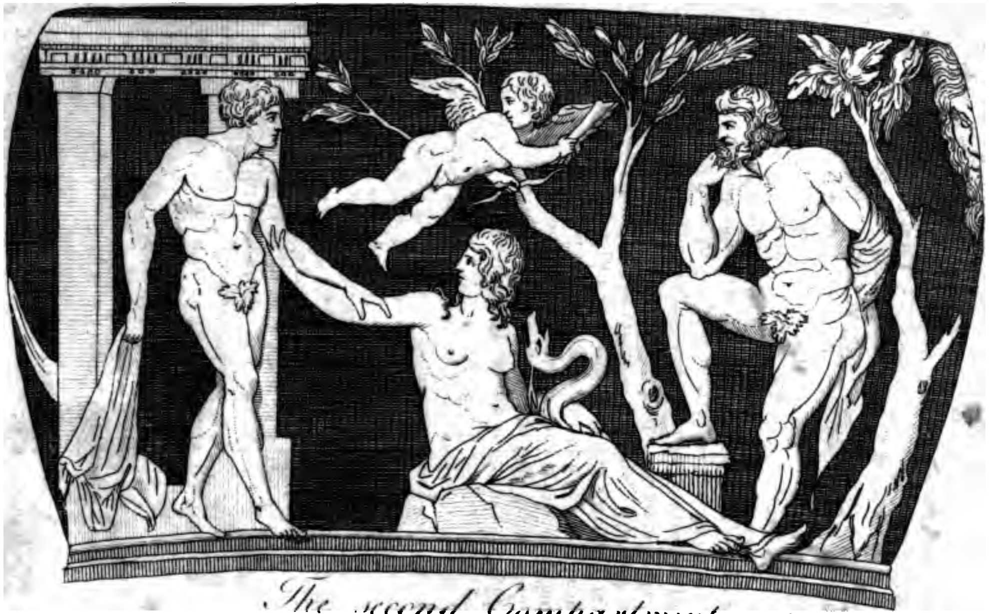
Three figures of exquiſite workmanſhip are placed by the ſide of a ruined column, whoſe capital is fallen off, and lies at their feet with other disjointed ſtones; they ſit on looſe piles of ſtone, beneath a tree, which has not the leaves of any evergreen of this climate, but may be ſuppoſed to be an elm, which Virgil places near the entrance of the infernal regions, and adds, that a dream was believed to dwell under every leaf of it. Æn. VI. l. 281. In the midſt of this group reclines a female figure in a dying attitude, in which extreme languor is beautifully repreſented; in her hand is an inverted torch, an ancient emblem of extinguiſhed life; the elbow of the ſame arm reſting on a ſtone, ſupports her as ſhe ſinks, while the other hand is raiſed, and thrown over her drooping head, in ſome meaſure ſuſtaining it, and gives, with great art, the idea of fainting laſſitude. On the right of her ſits a man, and on the left a woman, both ſupporting themſelves on their arms, as people are liable to do when they are thinking intenſely. They have their backs towards the dying figure, yet with their faces turned towards her, as if ſeriouſly contemplating her ſituation, but without ſtretching out their hands to aſſiſt her.

This central figure, then, appears to me to be an hieroglyphic, or Eleuſinian emblem of MORTAL LIFE, that is, the lethum, or death, mentioned by Virgil amongſt the terrible things exhibited at the beginning of the myſteries. The inverted torch ſhews the figure to be emblematic; if it had been deſigned to repreſent a real perſon in the act of dying, there had been no neceſſity for the expiring torch, as the dying figure alone would have been ſufficiently intelligible;—it would have been as abſurd as to have put an inverted torch into the hand of a real perſon at the time of his expiring. Beſides, if this figure had repreſented a real dying perſon, would not the other figures, or one of them at leaſt, have ſtretched out a hand to ſupport her, to have eaſed her fall among looſe ſtones, or to have ſmoothed her pillow? Theſe circumſtances evince that the figure is an emblem, and, therefore, could not be a repreſentation of the private hiſtory of any particular family or event.

The man and woman on each ſide of the dying figure muſt be conſidered as emblems, both from their ſimilarity of ſituation and dreſs to the middle figure, and their being grouped along with it. Theſe, I think, are hieroglyphic or Eleuſinian emblems of HUMANKIND, with their backs toward the dying figure of MORTAL LIFE, unwilling to aſſociate with her, yet turning back their ſerious and attentive countenances, curious indeed to behold, yet ſorry to contemplate their latter end. Theſe figures bring ſtrongly to one's mind the Adam and Eve of ſacred writ, whom ſome have ſuppoſed to have been allegorical or hieroglyphic perſons of Egyptian origin, but of more ancient date; amongſt whom, I think, is Dr. Warburton. According to this opinion, Adam and Eve were the names of two hieroglyphic figures, repreſenting the early ſtate of mankind; Abel was the name of an hieroglyphic figure, repreſenting the age of paſturage; and Cain, the name of another hieroglyphic ſymbol, repreſenting the age of agriculture; at which time the uſes of iron were diſcovered. And as the people who cultivated the earth, and built houſes, would increaſe in numbers much faſter by their greater production of food, they would readily conquer or deſtroy the people who were ſuſtained by paſturage, which was typified by Cain ſlaying Abel.

2. On the other compartment of this celebrated vaſe, is exhibited an emblem of immortality, the repreſentation of which was well known to conſtitute a very principal part of the ſhews at the Eleuſinian myſteries, as Dr. Warburton has proved by variety of authority. The habitation of ſpirits or ghoſts, after death, was ſuppoſed by the ancients to be placed beneath the earth, where Pluto reigned, and diſpenſed rewards or puniſhments. Hence the firſt figure in this group is of the MANES, or GHOST, who, having paſſed through an open portal, is deſcending into a duſky region, pointing his toe with timid and unſteady ſtep, feeling, as it were, his way in the gloom. This portal Æneas enters, which is deſcribed by Virgil,—patet atri janua Ditis, Æn. VI. l. 126; as well as the eaſy deſcent,—facilis deſcenſus Averni. Ib. The darkneſs at the entrance to the ſhades is humorouſly deſcribed by Lucian. Div. Legat. vol. I. p. 241. And the horror of the gates of hell was, in the time of Homer, become a proverb. Achilles ſays to Ulyſſes, " I hate a lyar worſe than the gates of hell;" the ſame expreſſion is uſed in Iſaiah, ch. xxxviii. v. 10. The MANES, or GHOST, appears lingering and fearful, and wiſhes to drag after him a part of his mortal garment, which, however, adheres to the ſide of the portal through which he has paſſed. The beauty of this allegory would have been expreſſed by Mr. Pope, by " We feel the ruling paſſion ſtrong in death."

A little lower down in the group, the manes, or ghoſt, is received by a



The second Compartment.

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beautiful female, a ſymbol of IMMORTAL LIFE. This is evinced by her fondling between her knees a large and playful ſerpent, which, from its annually renewing its external ſkin, has, from great antiquity, even as early as the fable of Prometheus, been eſteemed an emblem of renovated youth. The ſtory of the ſerpent acquiring immortal life from the aſs of Prometheus, who carried it on his back, is told in Bacon's Works, vol. V. p. 462. quarto edit. Lond. 1778. For a ſimilar purpoſe a ſerpent was wrapped round the large hieroglyphic egg in the temple of Dioſcuri, as an emblem of the renewal of life from a ſtate of death. Bryant's Mythology, vol. II. p. 359. ſec. edit. On this account alſo the ſerpent was an attendant on Æſculapius, which ſeems to have been the name of the hieroglyphic figure of medicine. This ſerpent ſhews this figure to be an emblem, as the torch ſhewed the central figure of the other compartment to be an emblem; hence they agreeably correſpond, and explain each other, one repreſenting MORTAL LIFE, and the other IMMORTAL LIFE.

This emblematic figure of immortal life ſits down with her feet towards the figure of Pluto, but, turning back her face towards the timid ghoſt, ſhe ſtretches forth her hand, and, taking hold of his elbow, ſupports his tottering ſteps, as well as encourages him to advance, both which circumſtances are thus, with wonderful ingenuity, brought to the eye. At the ſame time the ſpirit looſely lays his hand upon her arm, as one walking in the dark would naturally do for the greater certainty of following his conductreſs; while the general part of the ſymbol of IMMORTAL LIFE, being turned toward the figure of Pluto, ſhews that ſhe is leading the phantom to his realms.

In the Pamphili gardens at Rome, Perſeus, in aſſiſting Andromeda to deſcend from the rock, takes hold of her elbow to ſteady or ſupport her ſtep, and ſhe lays her hand looſely on his arm, as in this figure. Admir. Roman Antiq.

The figure of PLUTO can not be miſtaken, as it is agreed by moſt of the writers who have mentioned this vaſe; his griſley beard, and his having one foot buried in the earth, denote the infernal monarch. He is placed at the loweſt part of the group, and, reſting his chin on his hand, and his arm upon his knee, receives the ſtranger-ſpirit with inquiſitive attention. It was before obſerved, that when people think attentively, they naturally reſt their bodies in ſome eaſy attitude, that more animal power may be employed on the thinking faculty. In this group of figures there is great art ſhewn in giving an idea of a deſcending plain, viz. from earth to Elyſium, and yet all the figures are, in reality, on a horizontal one. This wonderful deception is produced, firſt, by the deſcending ſtep of the manes, or ghoſt; ſecondly, by the arm of the ſitting figure of Immortal Life being raiſed up to receive him as he deſcends; and, laſtly, by Pluto having one foot ſunk into the earth.

There is yet another figure which is concerned in conducting the manes, or ghoſt, to the realms of Pluto, and this is LOVE. He precedes the deſcending ſpirit on expanded wings, lights him with his torch, and turning back his beautiful countenance, beckons him to advance. The ancient God of love was of much higher dignity than the modern Cupid. He was the firſt that came out of the great egg of night, (Heſiod. Theog. V. CXX. Briant's Mythol. vol. II. p. 348.) and is ſaid to poſſeſs the keys of the ſky, ſea, and earth. As he, therefore, led the way into this life, he ſeems to conſtitute a proper emblem for leading the way to a future life. See Bacon's works, vol. I. p. 568. and vol. III. p. 582. quarto edit.

The introduction of Love into this part of the myſteries requires a little further explanation. The Pſyche of the Egyptians was one of their moſt favourite emblems, and repreſented the ſoul, or a future life; it was originally no other than the aurelia, or butterfly, but in after time, was repreſented by a lovely female child, with the beautiful wings of that inſect. The aurelia, after its firſt ſtage as an eruca or caterpillar, lies for a ſeaſon in a manner dead, and is incloſed in a ſort of coffin; in this ſtate of darkneſs it remains all the winter; but, at the return of ſpring, it burſts its bonds and comes out with new life, and in the moſt beautiful attire. The Egyptians thought this a very proper picture of the ſoul of man, and of the immortality to which it aſpired. But as this was all owing to divine Love, of which Eros was an emblem, we find this perſon frequently introduced as a concomitant of the ſoul in general, or Pſyche. (Bryant's Mythol. vol. II. p. 386.) Eros, or divine Love, is for the ſame reaſon a proper attendant on the manes or ſoul after death, and much contributes to tell the ſtory, that is, to ſhew that a ſoul or manes is deſigned by the deſcending figure. From this figure of Love, M. D'Hancarville imagines that Orpheus and Eurydice are typified under the figure of the manes, and immortal life as above deſcribed. It may be ſufficient to anſwer, firſt, that Orpheus is always repreſented with a lyre, of which there are prints of four different gems in Spence's Polymetis, and Virgil ſo deſcribes him, Æn. VI. cytharâ fretus. And ſecondly, that it is abſurd to ſuppoſe that Eurydice was fondling and playing with a ſerpent that had ſlain her. Add to this, that Love ſeems to have been an inhabitant of the infernal regions, as exhibited in the myſteries; for Claudian, who treats more openly of the Eleuſinian myſteries, when they were held in leſs veneration, invokes the deities to diſcloſe to him their ſecrets, and amongſt other things, by what torch Love ſoftens Pluto.

*Dii, quibus in numerum, &c.*
*Vos mihi ſacrarum penetralia pandite rerum,*
*Et veſtri ſecreta poli, qua lampade Ditem*
*Flexit Amor.*

In this compartment there are two trees, whoſe branches ſpread over the figures; one of them has ſmoother leaves, like ſome evergreens, and might thence be ſuppoſed to have ſome alluſion to immortality, but they may perhaps have been deſigned only as ornaments, or to relieve the figures, or becauſe it was in groves, where theſe myſteries were originally celebrated. Thus Homer ſpeaks of the woods of Proſerpine, and mentions many trees in Tartarus, as preſenting their fruits to Tantalus; Virgil ſpeaks of the pleaſant groves of Elyſium; and in Spence's Polymetis there are prints of two ancient gems, one of Orpheus charming Cerberus with his lyre, and the other of Hercules binding him in a cord; each of them ſtanding by a

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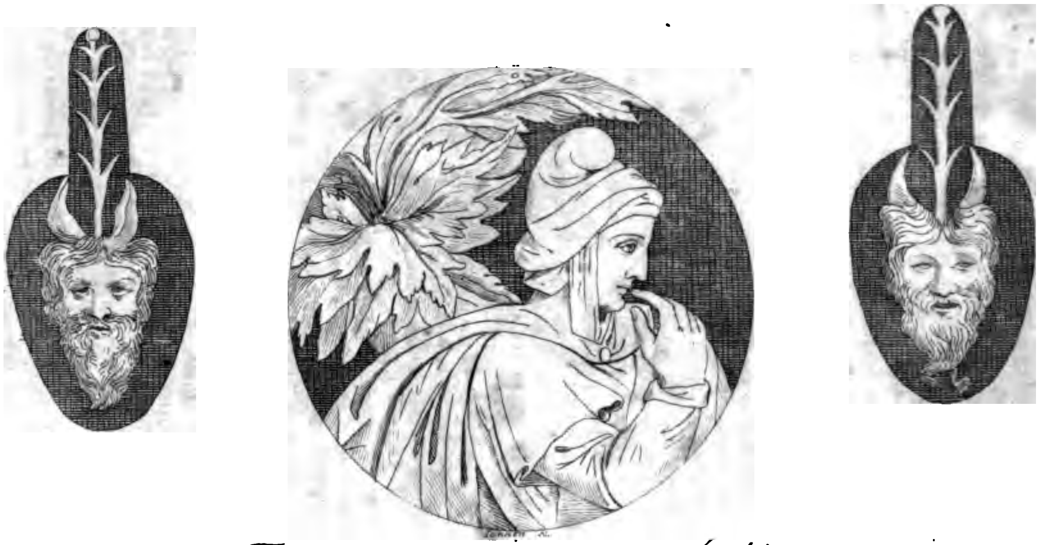

The Handles & Bottom of the Vase.

tree. Polymet. p. 284. As, however, theſe trees have all different foliage ſo clearly marked by the artiſt, they may have had ſpecific meanings in the exhibitions of the myſteries, which have not reached poſterity: of this kind ſeem to have been the tree of knowledge of good and evil, and the tree of life, in ſacred writ, both which muſt have been emblematic or allegorical. The maſks, hanging to the handles of the vaſe, ſeem to indicate that there is a concealed meaning in the figures beſides their general appearance. And the prieſteſs at the bottom, which I come now to deſcribe, ſeems to ſhew this concealed meaning to be of the ſacred or Eleuſinian kind.

3. The figure on the bottom of the vaſe, is on a larger ſcale than the others, and leſs finely finiſhed, and leſs elevated; and, as this bottom part was afterwards cemented to the upper part, it might be executed by another artiſt, for the ſake of expedition; but there ſeems no reaſon to ſuppoſe that it was not originally deſigned for the upper part of it, as ſome have conjectured. As the myſteries of Ceres were celebrated by female prieſts, for Porphyrius ſays the ancients called the prieſteſſes of Ceres, Meliſſai, or bees, which were emblems of chaſtity, Div. Leg. vol. I. p. 235. and, as in his Satire againſt the ſex, Juvenal ſays, that few women are worthy to be prieſteſſes of Ceres, Sat. VI. the figure at the bottom of the vaſe would ſeem to repreſent a PRIESTESS, or HIEROPHANT, whoſe office it was to introduce the initiated, and point out to them, and explain the exhibitions in the myſteries, and to exclude the uninitiated, calling out to them, "Far, far retire, ye profane!" and to guard the ſecrets of the temple. Thus the introductory hymn ſung by the hierophant, according to Euſebius, begins, "I will declare a ſecret to the initiated, but let the doors be ſhut againſt the profane." Div. Leg. vol. I. p. 177. The prieſteſs or hierophant appears in this figure, with a cloſe hood, and dreſſed in linen, which ſits cloſe about her; except a light cloak, which flutters in the wind. Wool, as taken from ſlaughtered animals, was eſteemed profane by the prieſts of Egypt, who were always dreſſed in linen. Apuleus, p. 64. Div. Leg. vol. I. p. 318. Thus Eli made for Samuel a linen ephod. Samuel i. 3.

Secrecy was the foundation on which all myſteries reſted; when publicly known, they ceaſed to be myſteries; hence a diſcovery of them was not only puniſhed with death by the Athenian law, but in other countries a diſgrace attended the breach of a ſolemn oath. The prieſteſs, in the figure before us, has her finger pointing to her lips, as an emblem of ſilence. There is a figure of Harpocrates, who was of Egyptian origin, the ſame as Orus, with the lotus on his head, and with his finger pointing to his lips, not preſſed upon them, in Bryant's Mythol. vol. II. p. 398. and another female figure ſtanding on a lotus, as if juſt riſen from the Nile, with her finger in the ſame attitude; theſe ſeem to have been repreſentations or emblems of male and female prieſts of the ſecret myſteries. As theſe ſorts of emblems were frequently changed by artiſts for their more elegant exhibition, it is poſſible the foliage over the head of this figure may bear ſome analogy to the lotus above-mentioned.

This figure of ſecrecy ſeems to be here placed, with great ingenuity, as a caution to the initiated, who might underſtand the meaning of the emblems round the vaſe, not to divulge it. And this circumſtance ſeems to account for there being no written explanation extant, and no tradition concerning theſe beautiful figures handed down to us along with them.

Another explanation of this figure, at the bottom of the vaſe, would ſeem to confirm the idea that the baſſo relievos round its ſides are repreſentations of a part of the myſteries; I mean that it is the head of ATIS. Lucian ſays that Atis was a young man of Phrygia, of uncommon beauty; that he dedicated a temple in Syria to Rhea, or Cybele, and firſt taught her myſteries to the Lydians, Phrygians, and Samothracians, which myſteries he brought from India. He was afterwards made an eunuch by Rhea, and lived like a woman, and aſſumed a feminine habit, and in that garb went over the world, teaching her ceremonies and myſteries. Dict. par M. Danet, art. Atis. As this figure is covered with clothes, while thoſe on the ſides of the vaſe are naked, and has a Phrygian cap on the head, and as the form and features are ſo ſoft, that it is difficult to ſay whether it be a male or female figure, there is reaſon to conclude, 1. That it has reference to ſome particular perſon of ſome particular country; 2. That this perſon is Atis, the firſt great hierophant, or teacher of myſteries, to whom M. De la Chauſſe ſays the figure itſelf bears a reſemblance. Muſeo. Capitol. Tom. IV. p. 402.

In the Muſeum Etruſcum, vol. I. plate 96, there is the head of Atis with feminine features, clothed with a Phrygian cap, and riſing from very broad foliage, placed on a kind of term, ſupported by the paw of a lion. Goreus, in his explanation of the figure, ſays that it is placed on a lion's foot becauſe that animal was ſacred to Cybele, and that it riſes from very broad leaves, becauſe after he became an eunuch, he determined to dwell in the groves. Thus the foliage, as well as the cap and feminine features, confirm the idea of this figure at the bottom of the vaſe, repreſenting the head of Atis, the firſt great hierophant; and that the figures on the ſides of the vaſe are emblems from the ancient myſteries.

I beg leave to add, that it does not appear to have been uncommon amongſt the ancients, to put allegorical figures on funeral vaſes. In the Pamphili palace at Rome, there is an elaborate repreſentation of Life and Death, on an ancient ſarcophagus. In the firſt Prometheus is repreſented making man, and Minerva is placing a butterfly, or the ſoul, upon his head. In the other compartment, Love extinguiſhes his torch in the boſom of the dying figure, and is receiving the butterfly, or Pſyche, from him, with a great number of complicated emblematic figures grouped in very bad taſte. Admir. Roman Antiq.

## NOTE XXIII.—COAL.

*Hence ſable Coal his maſſy couch extends,*
*And ſtars of gold the ſparkling Pyrite blends.* CANTO II. l. 349.

TO elucidate the formation of coal-beds, I ſhall here deſcribe a fountain of foſſil tar, or petroleum, diſcovered lately near Colebrook Dale, in Shropſhire, the particulars of which were ſent me by Dr. Robert Darwin, of Shrewſbury.

About a mile and a half below the celebrated iron-bridge, conſtructed by the late Mr. Darby, near Colebrook Dale, on the eaſt ſide of the river Severn, as the workmen, in October, 1786, were making a ſubterranean canal into the mountain, for the more eaſy acquiſition and conveyance of the coals which lie under it, they found an oozing of liquid bitumen, or petroleum; and as they proceeded further, cut through ſmall cavities of different ſizes, from which the bitumen iſſued. From ten to fifteen barrels of this foſſil tar, each barrel containing thirty-two gallons, were at firſt collected in a day, which has ſince, however, gradually diminiſhed in quantity, ſo that at preſent the product is about ſeven barrels in fourteen days.

The mountain into which this canal enters, conſiſts of ſiliceous ſand, in which, however, a few marine productions, apparently in their recent ſtate, have been found, and are now in the poſſeſſion of Mr. William Reynolds, of Ketly Bank. About three hundred yards from the entrance into the mountain, and about twenty-eight yards below the ſurface of it, the tar is found oozing from the ſand-rock above, into the top and ſides of the canal.

Beneath the level of this canal, a ſhaft has been ſunk through a grey argillaceous ſubſtance, called, in this country, clunch, which is ſaid to be a pretty certain indication of coal; beneath this lies a ſtratum of coal, about two or three inches thick, of an inferior kind, yielding little flame in burning, and leaving much aſhes; below this is a rock of a harder texture; and beneath this are found coals of an excellent quality; for the purpoſe of procuring which with greater facility, the canal, or horizontal aperture, is now making into the mountain. July, 1788.

Beneath theſe coals in ſome places is found ſalt water; in other parts of the adjacent country, there are beds of iron-ſtone, which alſo contain ſome bitumen in a leſs fluid ſtate, and which are about on a level with the new canal, into which the foſſil tar oozes, as above deſcribed.

There are many intereſting circumſtances attending the ſituation and accompaniments of this fountain of foſſil tar, tending to develope the manner of its production. 1. As the canal paſſing into the mountain runs over the beds of coals, and under the reſervoir of petroleum, it appears that a *natural diſtillation* of this foſſil, in the bowels of the earth, muſt have taken place at ſome early period of the world, ſimilar to the artificial diſtillation of coal, which has many years been carried on in this place on a ſmaller ſcale above ground. When this reſervoir of petroleum was cut into, the ſlowneſs of its exſudation into the canal, was not only owing to its viſcidity, but to the preſſure of the atmoſphere, or to the neceſſity there was that air ſhould at the ſame time inſinuate itſelf into the ſmall cavities from which the petroleum deſcended. The exiſtence of ſuch a diſtillation at ſome ancient time, is confirmed by the thin ſtratum of coal beneath the canal, (which covers the hard rock,) having been deprived of its foſſil oil, ſo as to burn without flame, and thus to have become a natural coak, or foſſil charcoal, while the petroleum diſtilled from it is found in the cavities of the rock above it.

There are appearances in other places, which favour this idea of the natural diſtillation of petroleum: thus, at Matlock, inDerbyſhire, a hard bitumen is found adhering to the ſpar in the clefts of the lime-rocks, in the form of round drops about the ſize of peas; which could, perhaps, only be depoſited there in that form by ſublimation.

2. The ſecond deduction which offers itſelf is, that theſe beds of coal have been *expoſed to a conſiderable degree of heat*, ſince the petroleum above could not be ſeparated, as far as we know, by any other means, and that the good quality of the coals beneath the hard rock, was owing to the impermeability of this rock to the bituminous vapour, and to its preſſure being too great to permit its being removed by the elaſticity of that vapour. Thus, from the degree of heat, the degree of preſſure, and the permeability of the ſuperincumbent ſtrata, many of the phenomena attending coal-beds receive an eaſy explanation, which much accords with the ingenious theory of the earth by Dr. Hutton. Tranſ. of Edinb. vol. I.

In ſome coal works, the fuſion of the ſtrata of coal has been ſo light, that there remains the appearance of ligneous fibres, and the impreſſion of leaves, as at Bovey, near Exeter, and even ſeeds of vegetables, of which I have had ſpecimens from the collieries near Poleſworth, in Warwickſhire. In ſome, where the heat was not very intenſe, and the incumbent ſtratum not permeable to vapour, the foſſil oil has only riſen to the upper part of the coal-bed, and has rendered that much more inflammable than the lower parts of it, as in the collieries near Beaudeſert, the ſeat of the Earl of Uxbridge, in Staffordſhire, where the upper ſtratum is a perfect cannel, or candle-coal, and the lower of an inferior quality. Over the coal-beds near Sir H. Harpur's houſe, in Derbyſhire, a thin lamina of aſphaltum is found in ſome places near the ſurface of the earth, which would ſeem to be from a diſtillation of petroleum from the coals below, the more fluid part of which had, in proceſs of time, exhaled, or been conſolidated by its abſorption of air. In other coal-works the upper part of the ſtratum is of a worſe kind than the lower one, as at Alfreton and Denbigh, in Derbyſhire, owing to the ſuperincumbent ſtratum having permitted the exhalation of a great part of the petroleum; whilſt at Widdrington, in Northumberland, there is firſt a ſeam of coal about ſix inches thick, of no value, which lies under about four fathom of clay; beneath this is a white free-ſtone, then a hard ſtone, which the workmen there call a whin, then two fathoms of clay, then another white ſtone, and under that a vein of coals three feet nine inches thick, of a ſimilar nature to the Newcaſtle coal. Phil. Tranſ. Abridg. vol. VI. plate 2, p. 192. The ſimilitude between the circumſtances of this colliery, and of the coal beneath the fountain of tar above deſcribed, renders it highly probable, that this upper thin ſeam of coal has ſuffered a ſimilar diſtillation, and that the inflammable part of it had either been received into the clay above, in the form of ſulphur, which, when burnt in the open air, would produce alum; or had been diſſipated, for want of a receiver, where it could be condenſed. The former opinion is, perhaps, in this caſe, more probable, as in ſome other coal-beds, of which I have procured accounts, the ſurface of the coal beneath clunch or clay is of an inferior quality, as at Weſt Hallum, in Nottinghamſhire. The clunch probably from hence acquires its inflammable part, which, on calcination, becomes vitriolic acid. I gathered pieces of clunch, converted partially into alum, at a colliery near Bilſton, where the ground was ſtill on fire a few years ago.

The heat, which has thus pervaded the beds of moraſs, ſeems to have been the effect of the fermentation of their vegetable materials; as new hay ſometimes takes fire, even in ſuch very ſmall maſſes, from the ſugar it contains, and ſeems, hence, not to have been attended with any expulſion of lava, like the deeper craters of volcanos ſituated in the beds of granite.

3. The marine ſhells found in the looſe ſand-rock, above this reſervoir of petroleum, and the coal-beds beneath it, together with the exiſtence of ſea-ſalt beneath theſe coals, prove that theſe coal-beds have been *at the bottom of the ſea*, during ſome remote period of time, and were afterwards raiſed into their preſent ſituation by ſubterraneous expanſions of vapour. This doctrine is further ſupported by the marks of violence, which ſome coal-beds received at the time they were raiſed out of the ſea, as in the collieries at Mendip, in Somerſetſhire. In theſe are ſeven ſtrata of coals, equitant upon each other, with beds of clay and ſtone intervening; amongſt which clay are found ſhells and fern branches. In one part of this hill the ſtrata are disjoined, and a quantity of heterogeneous ſubſtances fill up the chaſm which disjoins them; on one ſide of this chaſm the ſeven ſtrata of coal are ſeen correſponding, in reſpect to their reciprocal thickneſs and goodneſs, with the ſeven ſtrata on the other ſide of the cavity, except that they have been elevated ſeveral yards higher. Phil. Tranſ. No. 360. Abridg. vol. V. p. 237.

The cracks in the coal-bed near Ticknall, in Derbyſhire, and in the ſandſtone rock over it, in both of which ſpecimens of lead-ore and ſpar are found, confirm this opinion of their having been forcibly raiſed up by ſubterraneous fires. Over the colliery at Brown-hills, near Lichfield, there is a ſtratum of gravel on the ſurface of the ground, which may be adduced as another proof to ſhew that thoſe coals had ſome time been beneath the ſea, or the bed of a river. Nevertheleſs, theſe arguments only apply to the collieries above-mentioned, which are few compared with thoſe which bear no marks of having been immerſed in the ſea.

On the other hand, the production of coals from moraſſes, as deſcribed in note XX. is evinced from the vegetable matters frequently found in them, and in the ſtrata over them; as fern-leaves in nodules of iron-ore, and from the bog-ſhells, or freſh water muſcles, ſometimes found over them, of both which I have what I believe to be ſpecimens; and is further proved, from ſome parts of theſe beds being only in part transformed to coal; and the other part ſtill retaining not only the form, but ſome of the properties of wood; ſpecimens of which are not unfrequent in the cabinets of the curious, procured from Loch Neigh, in Ireland, from Bovey, near Exeter, and other places; and from a famous cavern called the Temple of the Devil, near the town of Altorf, in Franconia, at the foot of a mountain covered with pine and ſavine, in which are found large coals reſembling trees of ebony; which are ſo far mineralized as to be heavy and compact; and ſo to effloreſce with pyrites in ſome parts as to crumble to pieces; yet from other parts white aſhes are produced on calcination, from which *fixed alkali* is procured; which evinces their vegetable origin. (Dict. Raiſonné, art. Charbon.) To theſe may be added another argument, from the oil which is diſtilled from coals, and which is analogous to vegetable oil, and does not exiſt in any bodies truly mineral. Keir's Chemical Dictionary, art. Bitumen.

Whence it would appear, that though moſt collieries, with their attendant ſtrata of clay, ſand-ſtone, and iron, were formed on the places where the vegetables grew, from which they had their origin; yet that other collections of vegetable matter were waſhed down from eminences, by currents of waters, into the beds of rivers, or the neighbouring ſeas, and were there accumulated at different periods of time, and underwent a great degree of heat, from their fermentation, in the ſame manner as thoſe beds of moraſs which had continued on the plains where they were produced. And that, by this fermentation, many of them had been raiſed from the ocean, with ſand and ſea-ſhells over them; and others from the beds of rivers, with accumulations of gravel upon them.

4. For the purpoſe of bringing this hiſtory of the products of moraſſes more diſtinctly to the eye of the reader, I ſhall here ſubjoin two or three accounts of ſinking or boring for coals, out of above twenty, which I have procured from various places, though the terms are not very intelligible, being the language of the overſeers of coal-works.

1. *Whitfield mine*, near the Pottery, in Staffordſhire. Soil 1 foot, brick-clay 3 feet, ſhale 4, metal which is hard brown, and falls in the weather, 42, coal 3, warrant clay 6, brown grit-ſtone 36, coal 3½, warrant clay 3½, baſs and metal 53½, hard-ſtone 4, ſhaly baſs 1½, coal 4, warrant clay depth unknown; in all about 55 yards.

2. *Coal-mine at Alfreton*, in Derbyſhire. Soil and clay 7 feet, fragments of ſtone 9, bind 13, ſtone 6, bind 34, ſtone 5, bind 2, ſtone 2, bind 10, coal 1½, bind 1½, ſtone 37, bind 7, ſoft coal 3, bind 3, ſtone 20, bind 16, coal 7½; in all about 61 yards.

3. *A baſſet coal-mine at Woolarton*, in Nottinghamſhire. Sand and gravel 6 feet, bind 21, ſtone 10, ſmut or effete coal 1, clunch 4, bind 21, ſtone 18, bind 18, ſtone-bind 15, ſoft coal 2, clunch and bind 21, coal 7; in all about 48 yards.

4. *Coal-mine at Weſt-Hallam*, in Nottinghamſhire. Soil and clay 7 feet, bind 48, ſmut 1½, clunch 4, bind 3, ſtone 2, bind 1, ſtone 1, bind 3, ſtone 1, bind 16, ſhale 2, bind 12, ſhale 3, clunch, ſtone, and a bed of cank, 54, ſoft coal 4, clay and dun 1, ſoft coal 4½, clunch and bind 21, coal 1, broad bind 26, hard coal 6; in all about 74 yards.

As theſe ſtrata generally lie inclined, I ſuppoſe, parallel with the lime-ſtone on which they reſt, the upper edges of them all come out to day, which is termed baſſetting; when the whole maſs was iginited by its fermentation, it is probable that the inflammable part of ſome ſtrata might thus more eaſily eſcape than of others, in the form of vapour, as dews are known to ſlide between ſuch ſtrata in the production of ſprings; which accounts for ſome coal-beds being ſo much worſe than others. See note XX.

From this account of the production of coals from moraſſes, it would appear, that coal-beds are not to be expected beneath maſſes of lime-ſtone. Nevertheleſs, I have been lately informed by my friend, Mr. Michel, of Thornhill, who, I hope, will ſoon favour the public with his geological inveſtigations, that the beds of chalk are the uppermoſt of all the lime-ſtones; and that they reſt on the granulated lime-ſtone, called ketton-ſtone; which, I ſuppoſe, is ſimilar to that which covers the whole country from Leadenham to Sleaford, and from Sleaford to Lincoln; and that, thirdly, coal-delphs are frequently found beneath theſe two uppermoſt beds of lime-ſtone.

Now, as the beds of chalk, and of granulated lime-ſtone may have been formed by alluviation, on or beneath the ſhores of the ſea, or in vallies of the land, it would ſeem, that ſome coal-countries, which, in the great commotions of the earth, had been ſunk beneath the water, were thus covered with alluvial lime-ſtone, as well as others with alluvial baſaltes, or common gravel-beds. Very extenſive plains, which now conſiſt of alluvial materials, were, in the early times, covered with water, which has ſince diminiſhed, as the ſolid parts of the earth have increaſed. For the ſolid parts of the earth, conſiſting chiefly of animal and vegetable recrements, muſt have originally been formed or produced from the water, by animal and vegetable proceſſes; and as the ſolid parts of the earth may be ſuppoſed to be thrice as heavy as water, it follows, that thrice the quantity of water muſt have vaniſhed, compared with the quantity of earth thus produced. This may account for many immenſe beds of alluvial materials, as gravel, rounded ſand, granulated lime-ſtone, and chalk, covering ſuch extenſive plains as Lincoln-heath, having become dry without the ſuppoſition of their having been again elevated from the ocean. At the ſame time we acquire the knowledge of one of the uſes or final cauſes of the organized world, not indeed very flattering to our vanity; that it converts water into earth, forming iſlands and continents by its recrements or exuviæ.

## NOTE XXIV.—GRANITE.

*Climb the rude ſteeps, the granite-cliffs ſurround.* CANTO II. l. 523.

THE loweſt ſtratum of the earth which human labour has arrived to, is granite; and of this, likewiſe, conſiſts the higheſt mountains of the world. It is known under variety of names, according to ſome difference in its appearance or compoſition, but is now generally conſidered by philoſophers as a ſpecies of lava; if it contains quartz, feltſpat, and mica, in diſtinct cryſtals, it is called granite; which is found, in Cornwall, in rocks; and in looſe ſtones in the gravel near Drayton, in Shropſhire, in the road towards Newcaſtle. If theſe parts of the compoſition be leſs diſtinct, or if only two of them be viſible to the eye, it is termed porphyry, trap, whin-ſtone, moorſtone, ſlate. And if it appears in a regular angular form, it is called baſaltes. The affinity of theſe bodies has lately been further well eſtabliſhed by Dr. Beddoes, in the Phil. Tranſ. vol. LXXX.

Theſe are all eſteemed to have been volcanic productions, that have undergone different degrees of heat. It is well known, that in Papin's digeſter water may be made red-hot by confinement, and will then diſſolve many bodies which otherwiſe are little or not at all acted upon by it. From hence it may be conceived, that under immenſe preſſure of ſuperincumbent materials, and by great heat, theſe maſſes of lava may have undergone a kind of aqueous ſolution, without any tendency to vitrifaction, and might thence have a power of ceyſtallization; whence all the varieties above-mentioned, from the different proportion of the materials, or the different degrees of heat they may have undergone in this aqueous ſolution. And that the uniformity of the mixture of the original earths, as of lime, argil, ſilex, magneſia, and barytes, which they contain, was owing to their boiling together a longer or ſhorter time before their elevation into mountains. See note XIX. art. 8.

The ſeat of volcanos ſeems to be principally, if not entirely, in theſe ſtrata of granite, as many of them are ſituated on granite mountains, and throw up, from time to time, ſheets of lava, which run down over the preceding ſtrata, from the ſame origin; and in this they ſeem to differ from the heat which has ſeparated the clay, coal, and ſand, in moraſſes, which would appear to have riſen from a kind of fermentation, and thus to have pervaded the whole maſs, without any expuition of lava.

All the lavas from Veſuvius contain one fourth part of iron, (Kirwan's Min.) and all the five primitive earths, viz. calcareous, argillaceous, ſiliceous, barytic, and magneſian earths, which are alſo evidently produced now, daily, from the recrements of animal and vegetable bodies. What is to be thence concluded? Has the granite ſtratum, in very ancient times, been produced like the preſent calcareous and ſiliceous maſſes, according to the ingenious theory of Dr. Hutton, who ſays new continents are now forming at the bottom of the ſea, to riſe in their turn; and that thus the terraqueous globe has been, and will be, eternal? Or ſhall we ſuppoſe, that this internal heated maſs of granite, which forms the nucleus of the earth, was a part of the body of the ſun, before it was ſeparated by an exploſion? Or was the ſun originally a planet, inhabited like ours, and a ſatellite to ſome other greater ſun, which has long been extinguiſhed by diffuſion of its light, and around which the preſent ſun continues to revolve, according to a conjecture of the celebrated Mr. Herſchell, and which conveys to the mind a moſt ſublime idea of the progreſſive and increaſing excellence of the works of the Creator of all things?

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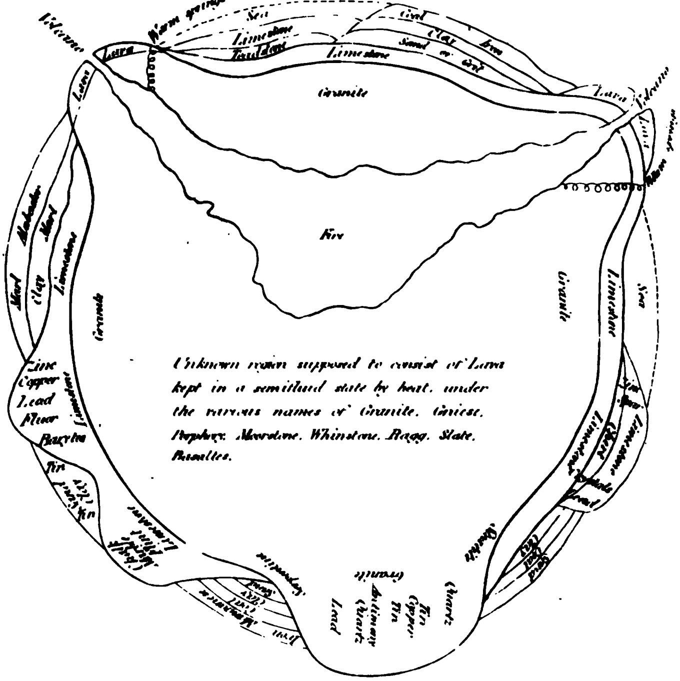
# Section of the Earth.



A sketch of a supposed Section of the Earth in respect to the disposition of the Strata over each other without regard to their proportions or number.

For the more eaſy comprehenſion of the facts and conjectures concerning the ſituation and production of the various ſtrata of the earth, I ſhall here ſubjoin a ſuppoſed ſection of the globe, but without any attempt to give the proportions of the parts, or the number of them, but only their reſpective ſituation over each other, and a geological recapitulation.

## GEOLOGICAL RECAPITULATION.

1. The earth was projected along with the other primary planets from the ſun, which is ſuppoſed to be on fire only on its ſurface, emitting light without much internal heat, like a ball of burning camphor.

2. The rotation of the earth round its axis, was occaſioned by its greater friction, or adheſion to one ſide of the cavity from which it was ejected; and from this rotation it acquired its ſpheroidical form. As it cooled in its aſcent from the ſun, its nucleus became harder; and its attendant vapours were condenſed, forming the ocean.

3. The maſſes or mountains of granite, porphyry, baſalt, and ſtones of ſimilar ſtructure, were a part of the original nucleus of the earth, or conſiſt of volcanic productions ſince formed.

4. On this nucleus of granite and baſaltes, thus covered by the ocean, were formed the calcareous beds of lime-ſtone, marble, chalk, ſpar, from the exuviæ of marine animals, with the flints, or chertz, which accompany them. And were ſtratified by their having been formed at different, and very diſtant periods of time.

5. The whole terraqueous globe was burſt by central fires; iſlands and continents were raiſed, conſiſting of granite, or lava, in ſome parts, and of lime-ſtone in others; and great vallies were ſunk, into which the ocean retired.

6. During theſe central earthquakes the moon was ejected from the earth, cauſing new tides; and the earth's axis ſuffered ſome change in its inclination, and its rotatory motion was retarded.

7. On ſome parts of theſe iſlands and continents of granite or lime-ſtone, were gradually produced extenſive moraſſes, from the recrements of vegetables and of land animals; and from theſe moraſſes, heated by fermentation, were produced clay, marl, ſand-ſtone, coal, iron (with the baſes of variety of acids); all which were ſtratified by their having been formed at different, and very diſtant periods of time.

8. In the elevation of the mountains, very numerous and deep fiſſures neceſſarily were produced. In theſe fiſſures many of the metals are formed, partly from deſcending materials, and partly from aſcending ones, raiſed in vapour by ſubterraneous fires. In the fiſſures of granite or porphyry, quartz is formed; in the fiſſures of lime-ſtone, calcareous ſpar is produced.

9. During theſe firſt great volcanic fires, it is probable the atmoſphere was either produced, or much increaſed; a proceſs which is, perhaps, now going on in the moon; Mr. Herſchell having diſcovered a volcanic crater three miles broad, burning on her diſk.

10. The ſummits of the new mountains were cracked into innumerable

lozenges by the cold dews, or ſnows, falling upon them when red-hot. From theſe ſummits, which were then twice as high as at preſent, cubes and lozenges of granite, and baſalt, and quartz, in ſome countries, and of marble and flints in others, deſcended gradually into the valleys, and were rolled together in the beds of rivers (which were then ſo large as to occupy the whole valleys, which they now only interſect); and produced the great beds of gravel, of which many valleys conſiſt.

11. In ſeveral parts of the earth's ſurface, ſubſequent earthquakes, from the fermentation of moraſſes, have, at different periods of time, deranged the poſition of the matters above deſcribed. Hence the gravel, which was before in the beds of rivers, has, in ſome places, been raiſed into mountains, along with clay and coal ſtrata, which were formed from moraſſes, and waſhed down from eminences into the beds of rivers, or the neighbouring ſeas, and in part raiſed again with gravel, or marine ſhells, over them; but this has only obtained in few places, compared with the general diſtribution of ſuch materials. Hence there ſeem to have exiſted two ſources of earthquakes, which have occurred at great diſtance of time from each other; one from the granite beds, in the central parts of the earth, and the other from the moraſſes on its ſurface. All the ſubſequent earthquakes and volcanos of modern days, compared with theſe, are of ſmall extent, and inſignificant effect.

12. Beſides the argillaceous ſand-ſtone produced from moraſſes, which is ſtratified with clay, and coal, and iron, other great beds of ſiliceous ſand have been formed in the ſea, by the combination of an unknown acid from moraſſes, and the calcareous matters of the ocean.

13. The warm waters which are found in many countries, are owing to ſteam ariſing from great depths, through the fiſſures of lime-ſtone or lava, elevated by ſubterranean fires, and condenſed between the ſtrata of the hills over them, and not from any decompoſition of pyrites or manganeſe near the ſurface of the earth.

14. The columns of baſaltes have been raiſed by the congelation or expanſion of granite beds, in the act of cooling, from their ſemi-vitreous ſuſion.

## NOTE XXV.—EVAPORATION.

*Aquatic Nymphs!—you lead with viewleſs march*
*The winged Vapours up the aerial arch.* CANTO III. l. 13.

I. THE atmoſphere will diſſolve a certain quantity of moiſture, as a chemical menſtruum, even when it is much below the freezing point, as appears from the diminution of ice ſuſpended in froſty air; but a much greater quantity of water is evaporated, and ſuſpended in the air, by means of heat, which is, perhaps, the univerſal cauſe of fluidity; for water is known to boil with leſs heat in vacuo, which is a proof that it will evaporate faſter in vacuo, and that the air, therefore, rather hinders than promotes its evaporation in higher degrees of heat. The quick evaporation occaſioned in vacuo by a ſmall degree of heat, is agreeably ſeen in what is termed a pulſe-glaſs, which conſiſts of an exhauſted tube of glaſs, with a bulb at each end of it, and with about two thirds of the cavity filled with alkohol, in which the ſpirit is inſtantly ſeen to boil, by the heat of the finger-end applied on a bubble of ſteam in the lower bulb, and is condenſed again in the upper bulb by the leaſt conceivable comparative coldneſs.

2. Another circumſtance, evincing that heat is the principal cauſe of evaporation, is, that at the time of water being converted into ſteam, a great quantity of heat is taken away from the neighbouring bodies. If a thermometer be repeatedly dipped in ether, or in rectified ſpirit of wine, and expoſed to a blaſt of air, to expedite the evaporation by perpetually removing the ſaturated air from it, the thermometer will preſently ſink below freezing. This warmth, taken from the ambient bodies at the time of evaporation by the ſteam, is again given out when the ſteam is condenſed into water. Hence the water in a worm-tub, during diſtillation, ſo ſoon becomes hot; and hence the warmth accompanying the deſcent of rain in cold weather.

3. The third circumſtance, ſhewing that heat is the principal cauſe of evaporation, is, that ſome of the ſteam becomes again condenſed when any part of the heat is withdrawn. Thus, when warmer ſouth-weſt winds, replete with moiſture, ſucceed the colder north-eaſt winds, all bodies that are denſe and ſubſtantial, as ſtone walls, brick floors, &c. abſorb ſome of the heat from the paſſing air, and its moiſture becomes precipitated on them; while the north-eaſt winds become warmer on their arrival in this latitude, and are thence diſpoſed to take up more moiſture, and are termed drying winds.

4. Heat ſeems to be the principal cauſe of the ſolution of many other bodies, as common ſalt, or blue vitriol, diſſolved in water, which, when expoſed to ſevere cold, are precipitated, or carried, to the part of the water laſt frozen; this I obſerved in a phial filled with a ſolution of blue vitriol, which was frozen: the phial was burſt, the ice thawed, and a blue column of cupreous vitriol was left ſtanding upright on the bottom of the broken glaſs, as deſcribed in note XIX. art. 3.

II. Hence water may either be diſſolved in air, and may then be called an aerial ſolution of water; or it may be diſſolved in the fluid matter of heat, according to the theory of M. Lavoiſier, and may then be called ſteam. In the former caſe, it is probable, there are many other vapours which may precipitate it, as marine acid gas, or fluor acid gas. So alkaline gas and acid gas, diſſolved in air, precipitate each other; nitrous gas precipitates vital air from its azote; and inflammable gas, mixed with vital air, ignited by an electric ſpark, either produces or precipitates the water in both of them. Are there any ſubtle exhalations, occaſionally diffuſed in the atmoſphere, which may thus cauſe rain?

1. But as water is, perhaps, many hundred times more ſoluble in the fluid matter of heat than in air, I ſuppoſe the eduction of this heat, by

whatever means it is occaſioned, is the principal cauſe of devaporation. Thus, if a region of air is brought from a warmer climate, as the S. W. winds, it becomes cooled by its contact with the earth in this latitude, and parts with ſo much of its moiſture as was diſſolved in the quantity of calorique, or heat, which it now loſes, but retains that part which was ſuſpended by its attraction to the particles of air, or by aerial ſolution, even in the moſt ſevere froſts.

2. A ſecond immediate cauſe of rain is a ſtream of N. E. wind deſcending from a ſuperior current of air, and mixing with the warmer S. W. wind below; or the reverſe of this, viz. a ſuperior current of S. W. wind mixing with an inferior one of N. E. wind: in both theſe caſes the whole heaven becomes inſtantly clouded, and the moiſture contained in the S. W. current is precipitated. This cauſe of devaporation has been ingeniouſly explained by Dr. Hutton, in the Tranſact. of Edinburgh, vol. I. and ſeems to ariſe from this circumſtance; the particles of air of the N. E. wind educe part of the heat from the S. W. wind, and therefore the water which was diſſolved by that quantity of *heat* is precipitated; all the other part of the water, which was ſuſpended by its attraction to the particles of air, or diſſolved in the remainder of the heat, continues unprecipitated.

3. A third method by which a region of air becomes cooled, and, in conſequence, depoſits much of its moiſture, is from the mechanical expanſion of air, when part of the preſſure is taken off. In this caſe the expanded air becomes capable of receiving or attracting more of the matter of heat into its interſtices; and the vapour, which was previouſly diſſolved in this heat, is depoſited, as is ſeen in the receiver of an air-pump, which becomes dewy, as the air within becomes expanded by the eduction of part of it. See note VII. Hence, when the mercury in the barometer ſinks without a change of the wind, the air generally becomes colder. See note VII. on Elementary Heat. And it is probably from the varying preſſure of the incumbent air, that in ſummer days ſmall black clouds are often thus ſuddenly produced, and again ſoon vaniſh. See a paper in Phil. Tranſ. vol. LXXVIII. entitled Frigorific Experiments on the Mechanical Expanſion of Air.

4. Another portion of atmoſpheric water may poſſibly be held in ſolution by the electric fluid, ſince, in thunder-ſtorms, a precipitation of the water ſeems to be either the cauſe or the conſequence of the eduction of the electricity. But it appears more probable that the water is condenſed into clouds by the eduction of its heat, and that then the ſurplus of electricity prevents their coaleſcence into larger drops, which immediately ſucceeds the departure of the lightning.

5. The immediate cauſe why the barometer ſinks before rain, is, firſt, becauſe a region of warm air, brought to us in the place of the cold air which it had diſplaced, muſt weigh lighter, both ſpecifically and abſolutely, if the height of the warm atmoſphere be ſuppoſed to be equal to that of the preceding cold one. And, ſecondly, after the drops of rain begin to fall in any column of air, that column becomes lighter, the falling drops only adding to the preſſure of the air in proportion to the reſiſtance which they meet with in paſſing through that fluid.

If we could ſuppoſe water to be diſſolved in air without heat, or in very low degrees of heat, I ſuppoſe the air would become heavier, as happens in many chemical ſolutions; but if water, diſſolved in the matter of heat, or calorique, be mixed with an aerial ſolution of water, there can be no doubt but an atmoſphere conſiſting of ſuch a mixture, muſt become lighter in proportion to the quantity of calorique. On the ſame circumſtance depends the viſible vapour produced from the breath of animals in cold weather, or from a boiling kettle; the particles of cold air with which it is mixed, ſteal a part of its heat, and become themſelves raiſed in temperature; whence part of the water is precipitated in viſible vapour, which, if in great quantity, ſinks to the ground; if in ſmall quantity, and the ſurrounding air is not previouſly ſaturated, it ſpreads itſelf till it becomes again diſſolved.

## NOTE XXVI.—SPRINGS.

*Your lucid bands condenſe with fingers chill*
*The blue miſt hovering round the gelid hill.* CANTO III. l. 19.

THE ſurface of the earth conſiſts of ſtrata, many of which were formed originally beneath the ſea; the mountains were afterwards forced up by ſubterraneous fires, as appears from the fiſſures in the rocks of which they conſiſt, the quantity of volcanic productions all over the world, and the numerous remains of craters of volcanos in mountainous countries. Hence the ſtrata which compoſe the ſides of mountains lie ſlanting downwards, and one or two, or more, of the external ſtrata not reaching to the ſummit when the mountain was raiſed up, the ſecond or third ſtratum, or a more inferior one, is there expoſed to day; this may be well repreſented by forceably thruſting a blunt inſtrument through ſeveral ſheets of paper; a bur will ſtand up with the lowermoſt ſheet, ſtanding higheſt in the centre of it. On this uppermoſt ſtratum, which is colder as it is more elevated, the dews are condenſed in large quantities, and, ſliding down, paſs under the firſt, or ſecond, or third ſtratum, which compoſe the ſides of the hill, and either form a moraſs below, or a weeping rock, by oozing out in numerous places, or many of theſe leſs currents meeting together, burſt out in a more copious rill.

The ſummits of mountains are much colder than the plains in their vicinity, owing to ſeveral cauſes: 1. Their being, in a manner, inſulated or cut off from the common heat of the earth, which is always of 48 degrees, and perpetually counteracts the effect of external cold beneath that degree. 2. From their ſurfaces being larger in proportion to their ſolid contents, and hence their heat more expeditiouſly carried away by the ever-moving atmoſphere. 3. The increaſing rarity of the air as the mountain riſes. All thoſe bodies which conduct electricity well or ill, conduct the matter of heat likewiſe well or ill. See note VII. Atmoſpheric air is a bad conductor of electricity, and thence confines it on the body where it is accumulated; but, when it is made very rare, as in the exhauſted receiver, the electric aura paſſes away immediately to any diſtance. The ſame circumſtance probably happens in reſpect to heat, which is thus kept, by the denſer air on the plains, from eſcaping, but is diſſipated on the hills, where the air is thinner. 4. As the currents of air riſe up the ſides of mountains, they become mechanically rarefied, the preſſure of the incumbent column leſſening as they aſcend. Hence the expanding air abſorbs heat from the mountain as it aſcends, as explained in note VII. 5. There is another, and, perhaps, more powerful cauſe, I ſuſpect, which may occaſion the great cold on mountains, and in the higher parts of the atmoſphere, and which has not yet been attended to; I mean that the fluid matter of heat may probably gravitate round the earth, and form an atmoſphere on its ſurface, mixed with the aerial atmoſphere, which may diminiſh or become rarer, as it recedes from the earth's ſurface, in a greater proportion than the air diminiſhes.

6. The great condenſation of moiſture on the ſummits of hills has another cauſe, which is the daſhing of moving clouds againſt them: in miſty days this is often ſeen to have great effect on plains, where an eminent tree, by obſtructing the miſt as it moves along, ſhall have a much greater quantity of moiſture drop from its leaves, than falls at the ſame time on the ground in its vicinity. Mr. White, in his Hiſtory of Selborne, gives an account of a large tree ſo ſituated, from which a ſtream flowed, during a moving miſt, ſo as to fill the cart-ruts in a lane otherwiſe not very moiſt; and ingeniouſly adds, that trees planted about ponds of ſtagnant water, contribute much, by theſe means, to ſupply the reſervoir. The ſpherules which conſtitute a miſt or cloud, are kept from uniting by ſo ſmall a power, that a little agitation againſt the leaves of a tree, or the greater attraction of a flat moiſt ſurface, condenſes or precipitates them.

If a leaf has its ſurface moiſtened, and particles of water ſeparate from each other, as in a miſt, be brought near the moiſtened ſurface of a leaf, each particle will be attracted more by that plain ſurface of water on the leaf, than it can be by the ſurrounding particles of the miſt; becauſe globules only attract each other in one point, whereas a plain attracts a globule by a greater extent of its ſurface.

The common cold ſprings are thus formed on elevated grounds by the condenſed vapours, and hence are ſtronger when the nights are cold, after hot days, in ſpring, than even in the wet days of winter. For the warm atmoſphere, during the day, has diſſolved much more water than it can ſupport in ſolution during the cold of the night, which is thus depoſited in large quantities on the hills, and yet ſo gradually as to ſoak in between the ſtrata of them, rather than to ſlide off over their ſurfaces, like ſhowers of rain. The common heat of the internal parts of the earth is aſcertained by ſprings which ariſe from ſtrata of earth too deep to be affected by the heat of ſummer or the froſts of winter. Thoſe, in this country, are of 48 degrees of heat; thoſe about Philadelphia were ſaid, by Dr. Franklin, to be 52; whether this variation is to be accounted for by the difference of the ſun's heat on that country, according to the ingenious theory of Mr. Kirwan, or to the vicinity of ſubterranean fires, is not yet, I think, decided. There are, however, ſubterraneous ſtreams of water not exactly produced in this manner, as ſtreams iſſuing from fiſſures in the earth, communicating with the craters of old volcanos: in the Peak of Derbyſhire are many hollows, called ſwallows, where the land floods ſink into the earth, and come out at ſome miles diſtant, as at Ilam, near Aſhborne. See note on Fica, vol. II.

Other ſtreams of cold water ariſe from beneath the ſnow on the Alps and Andes, and other high mountains, which is perpetually thawing at its under ſurface by the common heat of the earth, and gives riſe to large rivers. For the origin of warm ſprings ſee note on Fucus, vol. II.

## NOTE XXVII.—SHELL FISH.

*You round Echinus ray his arrowy mail,*
*Give the keel'd Nautilus his oar and ſail;*
*Firm to his rock with ſilver cords ſuſpend*
*The anchor'd Pinna, and his Cancer-friend.* CANTO III. l. 67.

THE armour of the Echinus, or Sea hedge-hog, conſiſts generally of moveable ſpines; (*Linnæi Syſtem. Nat.* vol. I. p. 1102.) and, in that reſpect, reſembles the armour of the land animal of the ſame name. The irregular protuberances on other ſea-ſhells, as on ſome ſpecies of the Purpura, and Murex, ſerve them as a fortification againſt the attacks of their enemies.

It is ſaid that this animal foreſees tempeſtuous weather, and, ſinking to the bottom of the ſea, adheres firmly to ſea-plants, or other bodies, by means of a ſubſtance which reſembles the horns of ſnails. Above twelve hundred of theſe fillets have been counted, by which this animal fixes itſelf; and when afloat, it contracts theſe fillets between the baſis of its points, the number of which often amounts to two thouſand. Dict. Raiſonné. art. Ourſin. de mer.

There is a kind of Nautilus, called, by Linnæus, Argonauta, whoſe ſhell has but one cell: of this animal Pliny affirms, that having exonerated its ſhell by throwing out the water, it ſwims upon the ſurface, extending a web of wonderful tenuity, and bending back two of its arms, and rowing with the reſt, makes a ſail, and, at length, receiving the water, dives again. Plin. IX. 29. Linnæus adds to his deſcription of this animal, that like the Crab Diogenes, or Bernhard, it occupies a houſe not its own, as it is not connected to its ſhell, and is therefore foreign to it: who could have given credit to this if it had not been atteſted by ſo many who have, with their own eyes, ſeen this argonaut in the act of ſailing? Syſt. Nat. p. 1161.

The Nautilus, properly ſo named by Linnæus, has a ſhell, conſiſting of many chambers, of which cups are made in the Eaſt with beautiful painting and carving on the mother-pearl. The animal is ſaid to inhabit only the uppermoſt or open chamber, which is larger than the reſt; and that the reſt remain empty, except that the pipe, or ſiphunculus, which communicates from one to the other of them, is filled with an appendage of the animal, like a gut or ſtring. Mr. Hook, in his Philoſ. Exper. p. 306, imagines this to be a dilatable or compreſſible tube, like the air bladders of fiſh, and that, by contracting or permitting it to expand, it renders its ſhell buoyant, or the contrary. See note on Ulva, vol. II.

The Pinna, or Sea-wing, is contained in a two-valve ſhell, weighing ſometimes fifteen pounds, and emits a beard of fine long gloſſy ſilk-like fibres, by which it is ſuſpended to the rocks twenty or thirty feet beneath the ſurface of the ſea. In this ſituation it is ſo ſucceſsfully attacked by the eight-footed Polypus, that the ſpecies, perhaps, could not exiſt but for the exertions of the Cancer Pinnotheris, who lives in the ſame ſhell as a guard and companion. Amœn. Acad. vol. II. p. 48. Lin. Syſt. Nat. vol. I. p. 1159. and p. 1040.

The Pinnotheris, or Pinnophylax, is a ſmall crab, naked, like Bernard the Hermit, but is furniſhed with good eyes, and lives in the ſame ſhell with the Pinna; when they want food the Pinna opens it ſhell, and ſends its faithful ally to forage; but if the Cancer ſees the Polypus, he returns ſuddenly to the arms of his blind hoſteſs, who, by cloſing the ſhell, avoids the fury of her enemy; otherwiſe, when it has procured a booty, it brings it to the opening of the ſhell, where it is admitted, and they divide the prey. This was obſerved by Haſlequiſt, in his voyage to Paleſtine.

The Byſſus of the ancients, according to Ariſtotle, was the beard of the Pinna above-mentioned, but ſeems to have been uſed by other writers indiſcriminately for any ſpun material, which was eſteemed finer or more valuable than wool. Reaumur ſays, the threads of this Byſſus are not leſs fine or leſs beautiful than the ſilk, as it is ſpun by the ſilk-worm; the Pinna on the coaſt of Italy and Provence (where it is fiſhed up by iron-hooks fixed on long poles) is called the ſilk-worm of the ſea. The ſtockings and gloves manufactured from it, are of exquiſite fineneſs, but too warm for common wear, and are thence eſteemed uſeful in rheumatiſm and gout. Dict. Raiſonné, art. Pinne-marine. The warmth of the Byſſus, like that of ſilk, is probably owing to their being bad conductors of heat, as well as of electricity. When theſe fibres are broken by violence, this animal, as well as the muſcle, has the power to re-produce them like the common ſpiders, as was obſerved by M. Adanſon. As raw ſilk, and raw cobwebs, when ſwallowed, are liable to produce great ſickneſs (as I am informed) it is probable, the part of muſcles, which ſometimes diſagrees with the people who eat them, may be this ſilky web, by which they attach themſelves to ſtones. The large kind of Pinna contains ſome mother-pearl, of a reddiſh tinge, according to M. d'Argenville. The ſubſtance ſold under the name of Indian-weed, and uſed at the bottom of fiſh-lines, is probably a production of this kind; which, however, is ſcarcely to be diſtinguiſhed by the eye from the tendons of a rat's tail, after they have been ſeparated by putrefaction in water, and well cleaned and rubbed; a production, which I was once ſhewn as a great curioſity; it had the uppermoſt bone of the tail adhering to it, and was ſaid to have been uſed as an ornament in a lady's hair.

## NOTE XXVIII.—STURGEON.

*With worm-like beard his toothleſs lips array,*
*And teach the unweildy Sturgeon to betray.* CANTO III. l. 71.

THE Sturgeon, *Acipenſer, Strurio*, Lin. Syſt. Nat. vol. I. p. 403. is a fiſh of great curioſity, as well as of great importance; his mouth is placed under the head, without teeth, like the opening of a purſe, which he has the power to puſh ſuddenly out, or retract. Before this mouth, under the beak, or noſe, hang four tendrils, ſome inches long, and which ſo reſemble earth-worms, that at firſt ſight they may be miſtaken for them. This clumſy toothleſs fiſh is ſuppoſed, by this contrivance, to keep himſelf in good condition, the ſolidity of his fleſh evidently ſhewing him to be a fiſh of prey. He is ſaid to hide his large body amongſt the weeds near the ſea coaſt, or at the mouths of large rivers, only expoſing his cirrhi, or tendrils, which ſmall fiſh, or ſea inſects, miſtaking for real worms, approach for plunder, and are ſucked into the jaws of their enemy. He has been ſuppoſed by ſome to root into the ſoil at the bottom of the ſea or rivers; but the cirrhi, or tendrils above-mentioned, which hang from his ſnout over his mouth, muſt themſelves be very inconvenient for this purpoſe, and, as it has no jaws, it evidently lives by ſuction, and, during its reſidence in the ſea, a quantity of ſea-inſects are found in its ſtomach.

The fleſh was ſo valued in the time of the Emperor Severus, that it was brought to table by ſervants with coronets on their heads, and preceded by muſic, which might give riſe to its being, in our country, preſented by the Lord Mayor to the King. At preſent it is caught in the Danube, and the Wolga, the Don, and other large rivers, for various purpoſes. The ſkin makes the beſt covering for carriages; iſinglaſs is prepared from parts of the ſkin; cavear from the ſpawn; and the fleſh is pickled, or ſalted, and ſent all over Europe.

## NOTE XXIX.—OIL ON WATER.

*Or with fine films, ſuſpended o'er the deep,*
*Of oil effuſive lull the waves to ſleep.* CANTO III. l. 87.

THERE is reaſon to believe, that when oil is poured upon water, the two ſurfaces do not touch each other, but that the oil is ſuſpended over the water by their mutual repulſion. This ſeems to be rendered probable by the following experiment: if one drop of oil be dropped on a baſon of water, it will immediately diffuſe itſelf over the whole, for there being no friction between the two ſurfaces, there is nothing to prevent its ſpreading itſelf by the gravity of the upper part of it, except its own tenacity, into a pellicle of the greateſt tenuity. But if a ſecond drop of oil be put upon the former, it does not ſpread itſelf, but remains in the form of a drop, as the other already occupied the whole ſurface of the baſon; and there is friction in oil paſſing over oil, though none in oil paſſing over water.

Hence, when oil is diffuſed on the ſurface of water, gentle breezes have no influence in raiſing waves upon it; for a ſmall quantity of oil will cover a very great ſurface of water (I ſuppoſe a ſpoonful will diffuſe itſelf over ſome acres), and the wind blowing upon this, carries it gradually forwards, and there being no friction between the two ſurfaces, the water is not affected. On which account oil has no effect in ſtilling the agitation of the water after the wind ceaſes, as was found by the experiments of Dr. Franklin.

This circumſtance, lately brought into notice by Dr. Franklin, had been mentioned by Pliny, and is ſaid to be in uſe by the divers for pearls, who, in windy weather, take down with them a little oil in their mouths, which they occaſionally give out, when the inequality of the ſupernatant waves prevents them from ſeeing ſufficiently diſtinctly for their purpoſe.

The wonderful tenuity with which oil can be ſpread upon water, is evinced by a few drops projected from a bridge, where the eye is properly placed over it, paſſing through all the priſmatic colours as it diffuſes itſelf. And alſo from another curious experiment of Dr. Franklin's; he cut a piece of cork to about the ſize of a letter-wafer, leaving a point ſtanding off like a tangent, at one edge of the circle. This piece of cork was then dipped in oil, and thrown into a large pond of water, and as the oil flowed off at the point, the cork-wafer continued to revolve in a contrary direction for ſeveral minutes. The oil flowing off all that time at the pointed tangent, in coloured ſtreams. In a ſmall pond of water this experiment does not ſo well ſucceed, as the circulation of the cork ſtops as ſoon as the water becomes covered with the pellicles of oil. See additional notes, No. XIII. and note on Fucus, vol. II.

The eaſe with which oil and water ſlide over each other, is agreeably ſeen if a phial be about half filled with equal parts of oil and water, and made to oſcillate, ſuſpended by a ſtring; the upper ſurface of the oil, and the lower one of the water, will always keep ſmooth: but the agitation of the ſurfaces where the oil and water meet, is curious; for their ſpecific gravities being not very different, and their friction on each other nothing, the higheſt ſide of the water, as the phial deſcends in its oſcillation, having acquired a greater momentum than the loweſt ſide (from its having deſcended further) would riſe the higheſt on the aſcending ſide of the oſcillation, and thence puſhes the then uppermoſt part of the water amongſt the oil.

## NOTE XXX.—SHIP-WORM.

*Meet fell Teredo, as he mines the keel*
*With beaked head, and break his lips of ſteel.* CANTO III. l. 91.

THE Teredo, or ſhip-worm, has two calcareous jaws, hemiſpherical, flat before, and angular behind. The ſhell is taper, winding, penetrating ſhips and ſubmarine wood, and was brought from India into Europe. Linnæi Syſtem. Nat. p. 1267. The Tarieres, or ſea-worms, attack and erode ſhips with ſuch fury, and in ſuch numbers, as often greatly to endanger them. It is ſaid that our veſſels have not known this new enemy above fifty years; that they were brought from the ſea about the Antilles, to our parts of the ocean, where they have increaſed prodigiouſly. They bore their paſſage in the direction of the fibres of the wood, which is their nouriſhment, and cannot return or paſs obliquely, and thence when they come to a knot in the wood, or when two of them meet together, with their ſtony mouths, they periſh for want of food.

In the years 1731 and 1732, the United Provinces were under a dreadful alarm concerning theſe inſects, which had made great depredation on the piles which ſupport the banks of Zealand; but it was happily diſcovered a few years afterwards, that theſe inſects had totally abandoned that iſland (Dict. Raiſonné, art. Vers Rongeurs), which might have been occaſioned by their not being able to live in that latitude, when the winter was rather ſeverer than uſual.

## NOTE XXXI.—MAELSTROM.

*Turn the broad helm, the fluttering canvas urge*
*From Maelſtrom's fierce innavigable ſurge.* CANTO III. l. 93.

ON the coaſt of Norway there is an extenſive vortex, or eddy, which lies between the iſlands of Moſkoe and Moſkenas, and is called Moſkoeſtrom, or Maelſtrom; it occupies ſome leagues in circumference, and is ſaid to be very dangerous, and often deſtructive, to veſſels navigating theſe ſeas. It is not eaſy to underſtand the exiſtence of a conſtant deſcending ſtream, without ſuppoſing it muſt paſs through a ſubterranean cavity, to ſome other part of the earth or ocean which may lie beneath its level; as the Mediterranean ſeems to lie beneath the level of the Atlantic ocean, which, therefore, conſtantly flows into it through the Straits; and the waters of the Gulph of Mexico lie much above the level of the ſea about the Floridas, and farther northward, which gives riſe to the Gulph-ſtream, as deſcribed in note on Caſſia, in vol. II.

The Maelſtrom is ſaid to be ſtill twice in about twenty-four hours, when the tide is up, and moſt violent at the oppoſite times of the day. This is not difficult to account for, ſince, when ſo much water is brought over the ſubterraneous paſſage, if ſuch exiſts, as completely to fill it, and ſtand many feet above it, leſs diſturbance muſt appear on the ſurface. The Maelſtrom is deſcribed in the Memoires of the Swediſh Academy of Sciences, and Pontopiddan's Hiſtory of Norway, and in the Univerſal Muſeum for 1763, p. 131.

The reaſon why eddies of water become hollow in the middle is, becauſe the water immediately over the centre of the well, or cavity, falls faſter, having leſs friction to oppoſe its deſcent, than the water over the circumference or edges of the well. The circular motion, or gyration of eddies, depends on the obliquity of the courſe of the ſtream, or to the friction or oppoſition to it being greater on one ſide of the well than the other: I have obſerved in water paſſing through a hole in the bottom of a trough, which was always kept full, the gyration of the ſtream might be turned either way by increaſing the oppoſition of one ſide of the eddy with one's finger, or by turning the ſpout, through which the water was introduced, a little more obliquely to the hole on one ſide or on the other. Lighter bodies are liable to be retained long in eddies of water, while thoſe rather heavier than water, are ſoon thrown out beyond the circumference, by their acquired momentum becoming greater than that of the water. Thus, if equal portions of oil and water be put into a phial, and, by means of a ſtring, be whirled in a circle round the hand, the water will always keep at the greater diſtance from the centre; whence, in the eddies formed in rivers during a flood, a perſon who endeavours to keep above water, or to ſwim, is liable to be detained in them, but on ſuffering himſelf to ſink, or dive, he is ſaid readily to eſcape. This circulation of water, in deſcending through a hole in a veſſel, Dr. Franklin has ingeniouſly applied to the explanation of hurricanes, or eddies of air.

## NOTE XXXII.—GLACIERS.

*Where round dark crags indignant Waters bend*
*Through rifted ice, in ivory veins deſcend.* Canto III. l. 115.

THE common heat of the interior parts of the earth being always 48 degrees, both in winter and ſummer, the ſnow which lies in contact with it is always in a thawing ſtate. Hence, in ice-houſes, the external part of the collection of ice is perpetually thawing, and thus preſerves the internal part of it, ſo that it is neceſſary to lay up many tons for the preſervation of one ton. Hence, in Italy, conſiderable rivers have their ſource from beneath the eternal glaciers, or mountains of ſnow and ice.

In our country, when the air, in the courſe of a froſt, continues a day or two at very near 32 degrees, the common heat of the earth thaws the ice on its surface, while the thermometer remains at the freezing point. This circumſtance is often obſervable in the rimy mornings of ſpring; the thermometer ſhall continue at the freezing point, yet all the rime will vaniſh, except that which happens to lie on a bridge, a board, or on a cake of cow-dung, which, being thus, as it were, inſulated or cut off from ſo free a communication with the common heat of the earth, by means of the air under the bridge, or wood, or dung, which are bad conductors of heat, continues ſome time longer unthawed. Hence, when the ground is covered thick with ſnow, though the froſt continues, and the ſun does not ſhine, yet the ſnow is obſerved to decreaſe very ſenſibly. For the common heat of the earth melts the under ſurface of it, and the upper one evaporates by its ſolution in the air. The great evaporation of ice was obſerved by Mr. Boyle, which experiment I repeated ſome time ago. Having ſuſpended a piece of ice by a wire, and weighed it with care, without touching it with my hand, I hung it out the whole of a clear froſty night, and found, in the morning, it had loſt nearly a fifth of its weight. Mr. N. Wallerius has ſince obſerved, that ice, at the time of its congelation, evaporates faſter than water in its fluid form; which may be accounted for from the heat given out at the inſtant of freezing; (Sauſſure's Eſſais ſur Hygromet. p. 249.) but this effect is only momentary.

Thus the vegetables that are covered with ſnow are ſeldom injured; ſince, as they lie between the thawing ſnow, which has 32 degrees of heat, and the covered earth, which has 48, they are preſerved in a degree of heat between theſe, viz. in 40 degrees of heat. Whence the moſs on which the rein-deer feed, in the northern latitudes, vegetates beneath the ſnow; (See note on Muſchus, vol. II.) and hence many Lapland and Alpine plants periſhed through cold in the botanic garden at Upſal; for, in their native ſituations, though the cold is much more intenſe, yet at its very commencement they are covered deep with ſnow, which remains till late in the ſpring. For this fact ſee Amænit. Academ. vol. I. No. 48. In our climate ſuch plants do well covered with dried fern, under which they will grow, and even flower, till the ſevere vernal froſts ceaſe. For the increaſe of glaciers ſee note on Canto I. l. 529.

## NOTE XXXIII.—WINDS.

*While ſouthern Gales o'er weſtern oceans roll,*
*And Eurus ſteals his ice-winds from the Pole.* CANTO IV. l. 15.

THE theory of the winds is yet very imperfect, in part, perhaps, owing to the want of obſervations ſufficiently numerous of the exact times and places where they begin and ceaſe to blow, but chiefly to our yet imperfect knowledge of the means by which great regions of air are either ſuddenly produced or ſuddenly deſtroyed.

The air is perpetually ſubject to increaſe or diminution, from its combination with other bodies, or its evolution from them. The vital part of the air, called oxygene, is continually produced in this climate, from the perſpiration of vegetables in the ſunſhine, and probably from the action of light on clouds, or on water, in the tropical climates, where the ſun has greater power, and may exert ſome yet unknown laws of luminous combination. Another part of the atmoſphere, which is called azote, is perpetually ſet at liberty from animal and vegetable bodies by putrefaction or combuſtion, from many ſprings of water, from volatile alkali, and probably from fixed alkali, of which there is an exhauſtleſs ſource in the water of the ocean. Both theſe component parts of the air are perpetually again diminiſhed by their contact with the ſoil, which covers the ſurface of the earth, producing nitre. The oxygene is diminiſhed in the production of all acids, of which the carbonic and muriatic exiſt in great abundance. The azote is diminiſhed in the growth of animal bodies, of which it conſtitutes an important part, and in its combinations with many other natural productions.

They are both probably diminiſhed, in immenſe quantities, by uniting with the inflammable air, which ariſes from the mud of rivers and lakes at ſome ſeaſons, when the atmoſphere is light; the oxygene of the air producing water, and the azote producing volatile alkali, by their combinations with this inflammable air. At other ſeaſons of the year theſe principles may again change their combinations, and the atmoſpheric air be reproduced.

Mr. Lavoiſier found that one pound of charcoal, in burning, conſumed two pounds nine ounces of vital air, or oxygene. The conſumption of vital air, in the proceſs of making red-lead, may readily be reduced to calculation; a ſmall barrel contains about twelve hundred weight of this commodity; 1200 pounds of lead, by calcination, abſorb about 144 pounds of vital air: now, as a cubic foot of water weighs 1000 averdupois ounces, and as vital air is above 800 times lighter than water, it follows, that every barrel of red-lead contains nearly 2000 cubic feet of vital air. If this can be performed in miniature in a ſmall oven, what may not be done in the immenſe elaboratories of nature!

Theſe great elaboratories of nature include almoſt all her foſſil, as well as her animal and vegetable productions. Dr. Prieſtley obtained air of greater or leſs purity, both vital and azotic, from almoſt all the foſſil ſubſtances he ſubjected to experiment. Four ounce-weight of lava, from Iceland, heated in an earthen retort, yielded twenty ounce-meaſures of air.

| | | | | | |
|---|---|---|---|---|---|
| 4 | ounce-weight of | lava | gave | 20 | ounce-meaſures of air. |
| 7 | .......... | baſaltes | ... | 104 | ........... |
| 2 | .......... | toad-ſtone | ... | 40 | ........... |
| 1½ | .......... | granite | ... | 20 | ........... |
| 1 | .......... | elvain | ... | 30 | ........... |
| 7 | .......... | gypſum | ... | 230 | ........... |
| 4 | .......... | blue ſlate | ... | 230 | ........... |
| 4 | .......... | clay | ... | 20 | ........... |
| 4 | .......... | lime-ſtone ſpar | ... | 830 | ........... |
| 5 | .......... | lime-ſtone | ... | 1160 | ........... |

| | | | |
|---|---|---|---|
| 3 ounce-weight of | chalk | gave 630 | ounce-meaſures of air. |
| 3½ | white iron-ore | 560 | |
| 4 | dark iron-ore | 410 | |
| ½ | molybdena | 25 | |
| ¼ | ſtream tin | 20 | |
| 2 | ſteatites | 40 | |
| 2 | barytes | 26 | |
| 2 | black wad | 80 | |
| 4 | ſand-ſtone | 75 | |
| 3 | coal | 700 | |

In this account the fixed air was previouſly extracted from the lime-ſtones by acids, and the heat applied was much leſs than was neceſſary to extract all the air from the bodies employed. Add to this the known quantities of air which are combined with the calciform ores, as the ochres of iron, mangeneſe, calamy; grey ore of lead, and ſome idea may be formed of the great production of air in volcanic eruptions, as mentioned in note on Chunda, vol. II. and of the perpetual abſorptions and evolutions of whole oceans of air from every part of the earth.

But there would ſeem to be an officina aeris, a ſhop where air is both manufactured and deſtroyed in the greateſt abundance within the polar circles, as will hereafter be ſpoken of. Can this be effected by ſome yet unknown law of the congelation of aqueous or ſaline fluids, which may ſet at liberty their combined heat, and convert a part both of the acid and alkali of ſea-water into their component airs? Or, on the contrary, can the electricity of the northern lights convert inflammable air and oxygene into water, whilſt the great degree of cold at the poles unites the azote with ſome other baſe? Another officina aeris, or manufacture of air, would ſeem to exiſt within the tropics, or at the line, though in a much leſs quantity than at the poles, owing, perhaps, to the action of the ſun's light on the moiſture ſuſpended in the air, as will alſo be ſpoken of hereafter; but in all other parts of the earth theſe abſorptions and evolutions of air, in a greater or leſs degree, are perpetually going on in inconceivable abundance; increaſed, probably, and diminiſhed, at different ſeaſons of the year, by the approach or retroceſſion of the ſun's light: future diſcoveries muſt elucidate this part of the ſubject. To this ſhould be added, that as heat and electricity, and perhaps magnetiſm, are known to diſplace air, that it is not impoſſible but that the increaſed or diminiſhed quantities of theſe fluids diffuſed in the atmoſphere, may increaſe its weight as well as its bulk: ſince their ſpecific attractions, or affinities to matter, are very ſtrong, they probably alſo poſſeſs general gravitation to the earth; a ſubject which wants further inveſtigation. See note XXVI.

## SOUTH-WEST WINDS.

The velocity of the ſurface of the earth, in moving round its axis, diminiſhes from the equator to the poles. Whence, if a region of air, in this country, ſhould be ſuddenly removed a few degrees towards the north, it muſt conſtitute a weſtern wind, becauſe, from the velocity it had previouſly acquired in this climate, by its friction with the earth, it would, for a time, move quicker than the ſurface of the country it was removed to. The contrary muſt enſue when a region of air is tranſported from this country a few degrees ſouthward, becauſe the velocity it had acquired in this climate would be leſs than that of the earth's ſurface where it was removed to; whence it would appear to conſtitute a wind from the eaſt, while, in reality, the eminent parts of the earth would be carried againſt the too ſlow air. But if this tranſportation of air from ſouth to north be performed gradually, the motion of the wind will blow in the diagonal between ſouth and weſt. And, on the contrary, if a region of air be gradually removed from north to ſouth, it would alſo blow diagonally between the north and eaſt; from whence we may ſafely conclude, that all our winds in this country which blow from the north or eaſt, or any point between them, conſiſt of regions of air brought from the north; and that all our winds blowing from the ſouth or weſt, or from any point between them, are regions of air brought from the ſouth.

It frequently happens, during the vernal months, that after a north-eaſt wind has paſſed over us for ſeveral weeks, during which time the barometer has ſtood at above 30½ inches, it becomes ſuddenly ſucceeded by a ſouth-weſt wind, which alſo continues ſeveral weeks, and the barometer ſinks to nearly 28½ inches. Now, as two inches of the mercury in the barometer balance one-fifteenth part of the whole atmoſphere, an important queſtion here preſents itſelf: *What is become of all this air?*

1. This great quantity of air cannot be carried in a ſuperior current towards the line, while the inferior current flows towards the poles, becauſe then it would equally affect the barometer, which ſhould not, therefore, ſubſide from 30½ inches, to 28½, for ſix weeks together.

2. It cannot be owing to the air having loſt all the moiſture which was previouſly diſſolved in it, becauſe theſe warm ſouth-weſt winds are replete with moiſture; and the cold north-eaſt winds, which weigh up the mercury in the barometer to 31 inches, conſiſt of dry air.

3. It cannot be carried over the polar regions, and be accumulated on the meridian oppoſite to us, in its paſſage towards the line, as ſuch an accumulation would equal one-fifteenth of the whole atmoſphere, and cannot be ſuppoſed to remain in that ſituation for ſix weeks together.

4. It cannot depend on the exiſtence of tides in the atmoſphere, ſince it muſt then correſpond to lunar periods. Nor to accumulations of air from the ſpecific levity of the upper regions of the atmoſphere, ſince its degree of fluidity muſt correſpond with its tenuity, and conſequently ſuch great mountains of air cannot be ſuppoſed to exiſt for ſo many weeks together as the ſouth-weſt winds ſometimes continue.

5. It remains, therefore, that there muſt be, at this time, a great and ſudden abſorption of air, in the polar circle, by ſome unknown operation of nature, and that the ſouth wind runs in to ſupply the deficiency. Now, as this ſouth wind conſiſts of air brought from a part of the earth's ſurface

which moves faſter than it does in this climate, it muſt have, at the ſame time, a direction from the weſt, by retaining part of the velocity it had previouſly acquired. Theſe ſouth-weſt winds, coming from a warmer country, and becoming colder by their contact with the earth of this climate, and by their expanſion (ſo great a part of the ſuperincumbent atmoſphere having vaniſhed), precipitate their moiſture; and as they continue for ſeveral weeks to be abſorbed in the polar circle, would ſeem to receive a perpetual ſupply from the tropical regions, eſpecially over the line, as will hereafter be ſpoken of.

It may ſometimes happen that a north-eaſt wind, having paſſed over us, may be bent down, and driven back, before it has acquired any heat from the climate, and may thus, for a few hours, or a day, have a ſouth-weſt direction, and from its deſcending from a higher region of the atmoſphere, may poſſeſs a greater degree of cold, than an inferior north-eaſt current of air.

The extreme cold of Jan. 13, 1709, at Paris, came on with a gentle ſouth wind, and was diminiſhed when the wind changed to the north, which is accounted for by Mr. Homberg, from a reflux of air which had been flowing for ſome time from the north. Chemical Eſſays by R. Watſon, vol. V, p. 182.

It may happen that a north-eaſt current may, for a day or two, paſs over us, and produce inceſſant rain, by mixing with the inferior ſouth-weſt current; but this, as well as the former, is of ſhort duration, as its friction will ſoon carry the inferior current along with it, and dry or froſty weather will then ſucceed.

## NORTH-EAST WINDS.

The north-eaſt winds of this country conſiſt of regions of air from the north, travelling ſometimes at the rate of about a mile in two minutes, during the vernal months, for ſeveral weeks together, from the polar regions toward the ſouth, the mercury in the barometer ſtanding above 30. Theſe winds conſiſt of air greatly cooled by the evaporation of the ice and ſnow over which it paſſes, and, as they become warmer by their contact with the earth of this climate, are capable of diſſolving more moiſture as they paſs along, and are thence attended with froſts in winter, and with dry hot weather in ſummer.

1. This great quantity of air cannot be ſupplied by ſuperior currents paſſing in a contrary direction from ſouth to north, becauſe ſuch currents muſt, as they ariſe into the atmoſphere a mile or two high, become expoſed to ſo great cold as to occaſion them to depoſit their moiſture, which would fall through the inferior current upon the earth in ſome part of their paſſage.

2. The whole atmoſphere muſt have increaſed in quantity, becauſe it appears by the barometer that there exiſts one-fifteenth part more air over us for many weeks together, which could not be thus accumulated by difference of temperature in reſpect to heat, or by any aeroſtatic laws at preſent known, or by any lunar influence.

From whence it would appear that immenſe maſſes of air were ſet at liberty from their combinations with ſolid bodies, along with a ſufficient quantity of combined heat, within the polar circle, or in ſome region to the north of us; and that they thus perpetually increaſe the quantity of the atmoſphere; and that this is again, at certain times, re-abſorbed, or enters into new combinations at the line or tropical regions. By which wonderful contrivance the atmoſphere is perpetually renewed, and rendered fit for the ſupport of animal and vegetable life.

## SOUTH-EAST WINDS.

The ſouth-eaſt winds of this country conſiſt of air from the north, which had paſſed by us, or over us, and before it had obtained the velocity of the earth's ſurface in this climate, had been driven back, owing to a deficiency of air now commencing at the polar regions. Hence theſe are generally dry or freezing winds, and if they ſucceed north-eaſt winds, ſhould prognoſticate a change of wind from north-eaſt to ſouth-weſt: the barometer is generally about 30. They are ſometimes attended with cloudy weather, or rain, owing to their having acquired an increaſed degree of warmth and moiſture before they became retrograde; or to their being mixed with air from the ſouth.

2. Sometimes theſe ſouth-eaſt winds conſiſt of a vertical eddy of north-eaſt air, without any mixture of ſouth-weſt air; in that caſe the barometer continues above 30, and the weather is dry or froſty for four or five days together.

It ſhould here be obſerved, that air being an elaſtic fluid, muſt be more liable to eddies than water, and that theſe eddies muſt extend into cylinders, or vortexes, of greater diameter, and that if a vertical eddy of north-eaſt air be of ſmall diameter, or has paſſed but a little way to the ſouth of us before its return, it will not have gained the velocity of the earth's ſurface to the ſouth of us, and will, in conſequence, become a ſouth-eaſt wind. But if the vertical eddy be of large diameter, or has paſſed much to the ſouth of us, it will have acquired velocity from its friction with the earth's ſurface to the ſouth of us, and will, in conſequence, on its return, become a ſouth-weſt wind, producing great cold.

## NORTH-WEST WINDS.

There ſeem to be three ſources of the north-weſt winds of this hemiſphere of the earth. 1. When a portion of ſouthern air, which was paſſing over us, is driven back by accumulation of new air in the polar regions. In this caſe I ſuppoſe they are generally moiſt or rainy winds, with the barometer under 30; and if the wind had previouſly been in the ſouth-weſt, it would ſeem to prognoſticate a change to the north-eaſt.

2. If a current of north wind is paſſing over us but a few miles high, without any eaſterly direction, and is bent down upon us, it muſt immediately poſſeſs a weſterly direction, becauſe it will now move faſter than the

ſurface of the earth where it arrives; and thus becomes changed from a north-eaſt to a north-weſt wind. The deſcent of a north-eaſt current of air producing a north-weſt wind, may continue ſome days with clear or freezing weather, as it may be ſimply owing to a vertical eddy of north-eaſt air, as will be ſpoken of below. It may otherwiſe be forced down by a current of ſouth-weſt wind paſſing over it; and in this caſe it will be attended with rain for a few days, by the mixture of the two airs of different degrees of heat; and will prognoſticate a change of wind from north-eaſt to ſouth-weſt, if the wind was previouſly in the north-eaſt quarter.

3. On the eaſtern coaſt of North-America the north-weſt winds bring froſt, as the north-eaſt winds do in this country, as appears from variety of teſtimony. This ſeems to happen from a vertical ſpiral eddy made in the atmoſphere, between the ſhore and the ridge of mountains which form the ſpine, or back-bone, of that continent. If a current of water runs along the hypothenuſe of a triangle, an eddy will be made in the included angle, which will turn round like a water-wheel as the ſtream paſſes in contact with one edge of it. The ſame muſt happen when a ſheet of air, flowing along from the north-eaſt, riſes from the ſhore, in a ſtraight line, to the ſummit of the Apalachian mountains; a part of the ſtream of north-eaſt air will flow over the mountains, another part will revert, and circulate ſpirally, between the ſummit of the country and the eaſtern ſhore, continuing to move toward the ſouth; and thus be changed from a north-eaſt to a north-weſt wind.

This vertical ſpiral eddy, having been in contact with the cold ſummits of theſe mountains, and deſcending from higher parts of the atmoſphere, will loſe part of its heat, and thus conſtitute one cauſe of the greater coldneſs of the eaſtern ſides of North-America than of the European ſhores oppoſite to them, which is ſaid to be equal to twelve degrees of north latitude, which is a wonderful fact, not otherwiſe eaſy to be explained, ſince the heat of the ſprings at Philadelphia is ſaid to be 52, which is greater than the medium heat of the earth in this country.

The exiſtence of vertical eddies, or great cylinders of air rolling on the ſurface of the earth, is agreeable to the obſervations of the conſtructors of wind-mills, who, on this idea, place the area of the ſails leaning backwards, inclined to the horizon, and believe that then they have greater power than when they are placed quite perpendicularly. The ſame kind of rolling cylinders of water obtain in rivers, owing to the friction of the water againſt the earth at their bottoms, as is known by bodies having been obſerved to float upon their ſurfaces quicker than when immerſed to a certain depth. Theſe vertical eddies of air probably exiſt all over the earth's ſurface, but particularly at the bottom or ſides of mountains, and more ſo, probably, in the courſe of the ſouth-weſt than of the north-eaſt winds, becauſe the former fall from an eminence, as it were, on a part of the earth where there is a deficiency of the quantity of air, as is ſhewn by the ſinking of the barometer: whereas the latter are puſhed or ſqueezed forward by an addition to the atmoſphere behind them, as appears by the riſing of the barometer.

## TRADE-WINDS.

A column of heated air becomes lighter than before, and will therefore aſcend, by the preſſure of the cold air which ſurrounds it, like a cork in water, or like heated ſmoke in a chimney.

Now, as the ſun paſſes twice over the equator for once over either tropic, the equator has not time to become cool; and, on this account, it is in general hotter at the line than at the tropics; and, therefore, the air over the line, except in ſome few inſtances hereafter to be mentioned, continues to aſcend at all ſeaſons of the year, preſſed upwards by regions of air brought from the tropics.

This air, thus brought from the tropics to the equator, would conſtitute a north wind on one ſide of the equator, and a ſouth wind on the other; but as the ſurface of the earth at the equator moves quicker than the ſurface of the earth at the tropics, it is evident that a region of air brought from either tropic to the equator, and which had previouſly only acquired the velocity of the earth's ſurface at the tropics, will now move too ſlow for the earth's ſurface at the equator, and will thence appear to move in a direction contrary to the motion of the earth. Hence the trade-winds, though they conſiſt of regions of air brought from the north on one ſide of the line, and from the ſouth on the other, will appear to have the diagonal direction of north-eaſt and ſouth-eaſt winds.

Now, it is commonly believed that there are ſuperior currents of air paſſing over theſe north-eaſt and ſouth-eaſt currents in a contrary direction, and which, deſcending near the tropics, produce vertical whirlpools of air. An important queſtion here again preſents itſelf: *What becomes of the moiſture which this heated air ought to depoſit, as it cools in the upper regions of the atmoſphere, in its journey to the tropics?* It has been ſhewn by Dr. Prieſtley and Mr. Ingenhouz, that the green matter at the bottom of ciſterns, and the freſh leaves of plants immerſed in water, give out conſiderable quantities of vital air in the ſunſhine; that is, the perſpirable matter of plants (which is water much divided in its egreſs from their minute pores), becomes decompoſed by the ſun's light, and converted into two kinds of air, the vital and inflammable airs. The moiſture contained or diſſolved in the aſcending heated air at the line, muſt exiſt in great tenuity; and, by being expoſed to the great light of the ſun in that climate, the water may be decompoſed, and the new airs ſpread on the atmoſphere from the line to the poles.

1. From there being no conſtant depoſition of rains in the uſual courſe of the trade-winds, it would appear that the water riſing at the line is decompoſed in its aſcent.

2. From the obſervations of M. Bougner, on the mountain Pinchinca, one of the Cordelieres immediately under the line, there appears to be no condenſible vapour above three or four miles high. Now, though the atmoſphere at that height may be cold to a very conſiderable degree, yet its total deprivation of condenſible vapour would ſeem to ſhew, that its water was decompoſed, as there are no experiments to evince that any degree of

cold hitherto known has been able to deprive air of its moiſture; and great abundance of ſnow is depoſited from the air that flows to the polar regions, though it is expoſed to no greater degrees of cold in its journey thither than probably exiſts at four miles height in the atmoſphere at the line.

3. The hygrometer of Mr. Sauſſure alſo pointed to dryneſs as he aſcended into rarer air; the ſingle hair of which it was conſtructed, contracting from deficiency of moiſture. Eſſais ſur l'Hygromet. p. 143.

From theſe obſervations it appears, either that rare and cold air requires more moiſture to ſaturate it than denſe air, or, that the moiſture becomes decompoſed, and converted into air, as it aſcends into theſe cold and rare regions of the atmoſphere.

4. There ſeems ſome analogy between the circumſtance of air being produced or generated in the cold parts of the atmoſphere, both at the line and at the poles.

## MONSOONS AND TORNADOES.

1. In the Arabian and Indian ſeas are winds which blow ſix months one way, and ſix months the other, and are called Monſoons; by the accidental diſpoſitions of land and ſea, it happens, that in ſome places the air near the tropic is ſuppoſed to become warmer when the ſun is vertical over it, than at the line. The air in theſe places conſequently aſcends, preſſed upon one ſide by the north-eaſt regions of air, and on the other ſide by the ſouth-weſt regions of air. For as the air brought from the ſouth has previouſly obtained the velocity of the earth's ſurface at the line, it moves faſter than the earth's ſurface near the tropic, where it now arrives, and becomes a ſouth-weſt wind, while the air from the north becomes a north-eaſt wind, as before explained. Theſe two winds do not ſo quietly join and aſcend as the north-eaſt and ſouth-eaſt winds, which meet at the line with equal warmth and velocity, and form the trade-winds; but as they meet in contrary directions before they aſcend, and cannot be ſuppoſed accurately to balance each other, a rotatory motion will be produced, as they aſcend, like water falling through a hole, and an horizontal or ſpiral eddy is the conſequence; theſe eddies are more or leſs rapid, and are called Tornadoes in their moſt violent ſtate, raiſing water from the ocean in the weſt, or ſand from the deſerts of the eaſt; in leſs violent degrees, they only mix together the two currents of north-eaſt and ſouth-weſt air, and produce, by this means, inceſſant rains, as the air of the north-eaſt acquires ſome of the heat from the ſouth-weſt wind, as explained in Note XXV. This circumſtance of the eddies produced by the monſoon-winds, was ſeen by Mr. Bruce in Abyſſinia: he relates, that for many ſucceſſive mornings, at the commencement of the rainy monſoon, he obſerved a cloud, of apparently ſmall dimenſion, whirling round with great rapidity, and, in a few minutes, the heavens became covered with dark clouds, with conſequent great rains. See note on Canto III. l. 129.

2. But it is not only at the place where the air aſcends, at the northern extremity of the rainy monſoon, and where it forms tornadoes, as obſerved

above by Mr. Bruce, but over a great tract of country, ſeveral degrees in length, in certain parts, as in the Arabian ſea, a perpetual rain for ſeveral months deſcends, ſimilar to what happens, for weeks together, in our own climate, in a leſs degree, during the ſouth-weſt winds. Another important queſtion preſents itſelf here: *If the climate to which this ſouth-weſt wind arrives is not colder than that it comes from, why ſhould it depoſit its moiſture during its whole journey? If it be a colder climate, why does it come thither?* The tornadoes of air above deſcribed can extend but a little way, and it is not eaſy to conceive, that a ſuperior cold current of air can mix with an inferior one, and thus produce ſhowers over ten degrees of country, ſince, at about three miles high, there is perpetual froſt; and what can induce theſe narrow and ſhallow currents to flow over each other ſo many hundred miles?

Though the earth, at the northern extremity of this monſoon, may be more heated by certain circumſtances of ſituation than at the line, yet it ſeems probable that the intermediate country between that and the line, may continue colder than the line (as in other parts of the earth), and hence, that the air coming from the line to ſupply this aſcent, or deſtruction of air, at the northern extremity of the monſoon, will be cooled all the way in its approach, and, in conſequence, depoſit its water. It ſeems probable, that at the northern extremity of this monſoon, where the tornadoes or hurricanes exiſt, that the air not only aſcends, but is in part converted into water, or otherwiſe diminiſhed in quantity, as no account is given of the exiſtence of any ſuperior currents of it.

As the ſouth-weſt winds are always attended with a light atmoſphere, an incipient vacancy, or a great diminution of air, muſt have taken place to the northward of them, in all parts of the earth wherever they exiſt; and a depoſition of their moiſture ſucceeds their being cooled by the climate they arrive at, and not by a contrary current of cold air over them, ſince, in that caſe, the barometer would not ſink. They may thus, in our own country, be termed monſoons without very regular periods.

3. Another cauſe of TORNADOES, independent of the monſoons, is ingeniouſly explained by Dr. Franklin; when, in the tropical countries, a ſtratum of inferior air becomes ſo heated by its contact with the warm earth, that its expanſion is increaſed more than is equivalent to the preſſure of the ſtratum of air over it; or when the ſuperior ſtratum becomes more condenſed by cold than the inferior one by preſſure, the upper region will deſcend, and the lower one aſcend. In this ſituation, if one part of the atmoſphere be hotter, from ſome fortuitous circumſtances, or has leſs preſſure over it, the lower ſtratum will begin to aſcend at this part, and reſemble water falling through a hole, as mentioned above. If the lower region of air was going forwards with conſiderable velocity, it will gain an eddy by riſing up this hole in the incumbent heavy air, ſo that the whirlpool, or tornado, has not only its progreſſive velocity, but its circular one alſo, which thus lifts up or overturns every thing within its ſpiral whirl. By the weaker whirlwinds in this country, the trees are ſometimes thrown down in a line of only twenty or forty yards in breadth, making a

kind of avenue through a country. In the Weſt-Indies the ſea riſes like a cone in the whirl, and is met by black clouds, produced by the cold upper air and the warm lower air being rapidly mixed; whence are produced the great and ſudden rains called water-ſpouts; while the upper and lower airs exchange their plus or minus electricity in perpetual lightnings.

## LAND AND SEA BREEZES.

The ſea, being a tranſparent maſs, is leſs heated at its ſurface by the ſun's rays than the land, and its continual change of ſurface contributes to preſerve a greater uniformity in the heat of the air which hangs over it. Hence the ſurface of the tropical iſlands is more heated during the day than the ſea that ſurrounds them, and cools more in the night, by its greater elevation; whence, in the afternoon, when the lands of the tropical iſlands have been much heated by the ſun, the air over them aſcends, preſſed upwards by the cooler air of the incircling ocean; in the morning, again, the land becoming cooled more than the ſea, the air over it deſcends by its increaſed gravity, and blows over the ocean, near its ſhores.

## CONCLUSION.

1. There are various irregular winds beſides thoſe above deſcribed, which conſiſt of horizontal or vertical eddies of air, owing to the inequality of the earth's ſurface, or the juxtapoſition of the ſea. Other irregular winds have their origin from increaſed evaporation of water, or its ſudden devaporation and deſcent in ſhowers; others from the partial expanſion and condenſation of air by heat and cold; by the accumulation or defect of electric fluid, or to the air's new production or abſorption, occaſioned by local cauſes not yet diſcovered. See notes VII. and XXV.

2. There ſeem to exiſt only two original winds: one conſiſting of air brought from the north, and the other of air brought from the ſouth. The former of theſe winds has alſo generally an apparent direction from the eaſt, and the latter from the weſt, ariſing from the different velocities of the earth's ſurface. All the other winds above deſcribed are deflections or retrogreſſions of ſome parts of theſe currents of air from the north or ſouth.

3. One fifteenth part of the atmoſphere is occaſionally deſtroyed, and occaſionally reproduced, by unknown cauſes. Theſe cauſes are brought into immediate activity over a great part of the ſurface of the earth, at nearly the ſame time, but always more powerful to the northward than to the ſouthward of any given place, and would hence ſeem to have their principal effect in the polar circles; exiſting, nevertheleſs, though with leſs power, toward the tropics or at the line.

For when the north-eaſt wind blows the barometer riſes, ſometimes from 28½ inches to 30½, which ſhews a great new generation of air in the north; and when the ſouth-weſt wind blows the barometer ſinks as much, which ſhews a great deſtruction of air in the north. But as the north-eaſt winds ſometimes continue for five or ſix weeks, the newly generated air muſt be deſtroyed at thoſe times in the warmer climates to the ſouth of us, or circulate in ſuperior currents, which has been ſhewn to be improbable from its not depoſiting its water. And as the ſouth-weſt winds ſometimes continue for ſome weeks, there muſt be a generation of air to the ſouth at thoſe times, or ſuperior currents, which laſt has been ſhewn to be improbable.

4. The north-eaſt winds, being generated about the poles, are puſhed forwards towards the tropics or line, by the preſſure from behind, and hence they become warmer, as explained in note VII. as well as by their coming into contact with a warmer part of the earth, which contributes to make theſe winds greedily abſorb moiſture in their paſſage. On the contrary, the ſouth-weſt winds, as the atmoſphere is ſuddenly diminiſhed in the polar regions, are drawn, as it were, into an incipient vacancy, and become, therefore, expanded in their paſſage, and thus generate cold, as explained in note VII. and are thus induced to part with their moiſture, as well as by their contact with a colder part of the earth's ſurface. Add to this, that the difference in the ſound of the north-eaſt and ſouth-weſt winds may depend on the former being puſhed forwards by a preſſure behind, and the latter falling, as it were, into a partial or incipient vacancy before; whence the former becomes more condenſed, and the latter more rarefied, as it paſſes. There is a whiſtle termed a lark-call, which conſiſts of a hollow cylinder of tin-plate, cloſed at each end, about half an inch in diameter, and a quarter of an inch high, with oppoſite holes, about the ſize of a gooſe-quill, through the centre of each end; if this lark-whiſtle be held between the lips, the ſound of it is manifeſtly different when the breath is forcibly blown through it from within outwards, and when it is ſucked from without inwards. Perhaps this might be worthy the attention of organ builders.

5. A ſtop is put to this new generation of air, when about a fifteenth of the whole is produced, by its increaſing preſſure; and a ſimilar boundary is fixed to its abſorption or deſtruction by the decreaſe of atmoſpheric preſſure. As water requires more heat to convert it into vapour under a heavy atmoſphere than under a light one, ſo in letting off the water from muddy fiſh-ponds, great quantities of air-bubbles are ſeen to aſcend from the bottom, which were previouſly confined there by the preſſure of the water. Similar bubbles of inflammable air are ſeen to ariſe from lakes in many ſeaſons of the year, when the atmoſphere ſuddenly becomes light.

6. The increaſed abſorptions and evolutions of air muſt, like its ſimple expanſions, depend much on the preſence or abſence of heat and light, and will hence, in reſpect to the times and places of its production and deſtruction, be governed by the approach or retroceſſion of the ſun, and on the temperature, in regard to heat, of various latitudes, and parts of the ſame latitude, ſo well explained by Mr. Kirwan.

7. Though the immediate cauſe of the deſtruction or re-production of great maſſes of air at certain times, when the wind changes from north to ſouth, or from ſouth to north, cannot yet be aſcertained; yet, as there appears greater difficulty in accounting for this change of wind from any other known cauſes, we may ſtill ſuſpect that there exiſts in the arctic and

antarctic circles, a **Bear** or **Dragon**, yet unknown to philoſophers, which, at times, ſuddenly drinks up, and as ſuddenly, at other times, vomits out one-fifteenth part of the atmoſphere; and hope that this or ſome future age will learn how to govern and domeſticate a monſter which might be rendered of ſuch important ſervice to mankind.

## INSTRUMENTS.

If, along with the uſual regiſters of the weather, obſervations were made on the winds in many parts of the earth, with the three following inſtruments, which might be conſtructed at no great expence, ſome uſeful information might be acquired.

1. To mark the hour when the wind changes from north-eaſt to ſouth-weſt, and the contrary. This might be managed by making a communication from the vane of a weather-cock to a clock, in ſuch a manner, that if the vane ſhould revolve quite round, a tooth on its revolving axis ſhould ſtop the clock, or put back a ſmall bolt on the edge of a wheel, revolving once in twenty-four hours.

2. To diſcover whether in a year more air paſſed from north to ſouth, or the contrary. This might be effected by placing a wind-mill-ſail of copper, about nine inches diameter, in a hollow cylinder, about ſix inches long, open at both ends, and fixed on an eminent ſituation, exactly north and ſouth. Thence only a part of the north-eaſt and ſouth-weſt currents would affect the ſail ſo as to turn it; and if its revolutions were counted by an adapted machinery, as the ſail would turn one way with the north currents of air, and the contrary one with the ſouth currents, the advance of the counting finger either way, would ſhew which wind had prevailed moſt at the end of the year.

3. To diſcover the rolling cylinders of air, the vane of a weather-cock might be ſo ſuſpended as to dip or riſe vertically, as well as to have its horizontal rotation.

## RECAPITULATION.

North-east winds conſiſt of air flowing from the north, where it ſeems to be occaſionally produced; has an apparent direction from the eaſt, owing to its not having acquired in its journey the increaſing velocity of the earth's ſurface; theſe winds are analogous to the trade-winds between the tropics, and frequently continue, in the vernal months, for four and ſix weeks together, with a high barometer, and fair or froſty weather. 2. They ſometimes conſiſt of ſouth-weſt air, which had paſſed by us or over us, driven back by a new accumulation of air in the north. Theſe continue but a day or two, and are attended with rain. See note XXV.

South-west winds conſiſt of air flowing from the ſouth, and ſeeming occaſionally abſorbed at its arrival to the more northern latitudes. It has a real direction from the weſt, owing to its not having loſt in its journey the greater velocity it had acquired from the earth's ſurface, from whence it came. Theſe winds are analogous to the monſoons between the tropics, and frequently continue for four or ſix weeks together, with a low barometer, and rainy weather. 2. They ſometimes conſiſt of north-eaſt air, which had paſſed by us or over us, which becomes retrograde by a commencing deficiency of air in the north. Theſe winds continue but a day or two, attended with ſeverer froſt, with a ſinking barometer; their cold being increaſed by their expanſion, as they return, into an incipient vacancy.

North-west winds conſiſt, firſt, of ſouth-weſt winds, which have paſſed over us, bent down, and driven back, towards the ſouth, by newly generated northern air. They continue but a day or two, and are attended with rain or clouds. 2. They conſiſt of north-eaſt winds bent down from the higher parts of the atmoſphere, and having there acquired a greater velocity than the earth's ſurface, are froſty and fair. 3. They conſiſt of north-eaſt winds formed into a vertical ſpiral eddy, as on the eaſtern coaſts of North-America, and bring ſevere froſt.

South-east winds conſiſt, firſt, of north-eaſt winds become retrograde; continue for a day or two; froſty or fair; ſinking barometer. 2. They conſiſt of north-eaſt winds formed into a vertical eddy, not a ſpiral one; froſt or fair.

North winds conſiſt, firſt, of air flowing ſlowly from the north, ſo that they acquire the velocity of the earth's ſurface as they approach; are fair or froſty; ſeldom occur. 2. They conſiſt of retrograde ſouth winds; theſe continue but a day or two; are preceded by ſouth-weſt winds; and are generally ſucceeded by north-eaſt winds; cloudy or rainy; barometer riſing.

South winds conſiſt, firſt, of air flowing ſlowly from the ſouth, loſing their previous weſtern velocity by the friction of the earth's ſurface as they approach; moiſt; ſeldom occur. 2. They conſiſt of retrograde north winds; theſe continue but a day or two; are preceded by north-eaſt winds; and generally ſucceeded by ſouth-weſt winds, colder, barometer ſinking.

East winds conſiſt of air brought haſtily from the north, and not impelled farther ſouthward, owing to a ſudden beginning abſorption of air in the northern regions, very cold, barometer high, generally ſucceeded by ſouth-weſt wind.

West winds conſiſt of air brought haſtily from the ſouth, and checked from proceeding further to the north, by a beginning production of air in the northern regions, warm and moiſt, generally ſucceeded by north-eaſt wind. 2. They conſiſt of air bent down from the higher regions of the atmoſphere; if this air be from the ſouth, and brought haſtily, it becomes a wind of great velocity, moving perhaps 60 miles in an hour, is warm and rainy; if it conſiſts of northern air bent down, it is of leſs velocity and colder.

### *Application of the preceding Theory to ſome Extracts from a Journal of the Weather.*

*Dec.* 1, 1790. The barometer ſunk ſuddenly, and the wind, which had been ſome days north-eaſt, with froſt, changed to ſouth-eaſt with an inceſſant though moderate fall of ſnow. A part of the northern air, which had paſſed by us I ſuppoſe, now became retrograde before it had acquired the velocity of the earth's ſurface to the ſouth of us, and being attended by ſome of the ſouthern air in its journey, the moiſture of the latter became condenſed and frozen by its mixture with the former.

*Dec.* 2, 3. The wind changed to north-weſt and thawed the ſnow. A part of the ſouthern air, which had paſſed by us or over us, with the retrograde northern air above deſcribed, was now in its turn driven back, before it had loſt the velocity of the ſurface of the earth to the ſouth of us, and, conſequently, became a north-weſt wind; and not having loſt the warmth it brought from the ſouth, produced a thaw.

*Dec.* 4, 5. Wind changed to north-eaſt, with froſt and a riſing barometer. The air from the north continuing to blow, after it had driven back the ſouthern air as above deſcribed, became a north-eaſt wind, having leſs velocity than the ſurface of the earth in this climate, and produced froſt from its coldneſs.

*Dec.* 6, 7. Wind now changed to the ſouth-weſt, with inceſſant rain and a ſinking barometer. From unknown cauſes, I ſuppoſe the quantity of air to be diminiſhed in the polar regions, and the ſouthern air cooled by the earth's ſurface, which was previouſly frozen, depoſits its moiſture for a day or two; afterwards the wind continued ſouth-weſt without rain, as the ſurface of the earth became warmer.

*March* 18, 1785. There has been a long froſt; a few days ago the barometer ſunk to 29½, and the froſt became more ſevere. Becauſe the air being expanded, by a part of the preſſure being taken off, became colder. This day the mercury roſe to 30, and the froſt ceaſed, the wind continuing as before, between north and eaſt. *March* 19. Mercury above 30, weather ſtill milder, no froſt, wind north-eaſt. *March* 20. The ſame; for the mercury riſing, ſhews that the air becomes more compreſſed by the weight above, and, in conſequence, gives out warmth.

*April* 4, 5. Froſt, wind north-eaſt; the wind changed in the middle of the day to the north-weſt, without rain, and has done ſo for three or four days, becoming again north-eaſt at night. For the ſun now giving greater degrees of heat, the air aſcends as the ſun paſſes the zenith, and is ſupplied below by the air on the weſtern ſide, as well as on the eaſtern ſide of the zenith, during the hot part of the day; whence, for a few hours, on the approach of the hot part of the day, the air acquires a weſterly direction in this longitude. If the north-weſt wind had been cauſed by a retrograde motion of ſome ſouthern air, which had paſſed over us, it would have been attended with rain or clouds.

*April* 10. It rained all day yeſterday, the wind north-weſt; this morning there was a ſharp froſt. The evaporation of the moiſture (which fell yeſterday), occaſioned by the continuance of the wind, produced ſo much cold as to freeze the dew.

*May* 12. Frequent ſhowers, with a current of colder wind preceding every ſhower. The ſinking of the rain or cloud preſſed away the air from beneath it in its deſcent, which, having been for a time ſhaded from the ſun by the floating cloud, became cooled in ſome degree.

*June* 20. The barometer ſunk, the wind became ſouth-weſt, and the whole heaven was inſtantly covered with clouds. A part of the incumbent atmoſphere having vaniſhed, as appeared by the ſinking of the barometer, the remainder became expanded by its elaſticity, and thence attracted ſome of the matter of heat from the vapour intermixed with it, and thus, in a few minutes, a total devaporation took place, as in exhauſting the receiver of an air-pump. See note XXV. At the place where the air is deſtroyed, currents both from the north and ſouth flow in to ſupply the deficiency (for it has been ſhewn that there are no other proper winds but theſe two), and the mixture of theſe winds produces ſo ſudden condenſation of the moiſture, both by the coldneſs of the northern air and the expanſion of both of them, that lightning is given out, and an incipient tornado takes place; whence thunder is ſaid frequently to approach againſt the wind.

*Auguſt* 28, 1732. Barometer was at 31, and *Dec.* 30, in the ſame year, it was at 28 2-tenths. Medical Eſſays, Edinburgh, vol. II. p. 7. It appears from theſe journals that the mercury at Edinburgh varies ſometimes nearly three inches, or one-tenth of the whole atmoſphere. From the journals kept by the Royal Society at London, it appears ſeldom to vary more than two inches, or one-fifteenth of the whole atmoſphere. The quantity of the variation is ſaid ſtill to decreaſe nearer the line, and to increaſe in the more northern latitudes; which much confirms the idea that there exiſts, at certain times, a great deſtruction or production of air within the polar circle.

*July* 2, 1732. The weſterly winds in the journal in the Medical Eſſays, vol. II. above referred to, are frequently marked with the number three, to ſhew their greater velocity, whereas the eaſterly winds ſeldom approach to the number two. The greater velocity of the weſterly winds than the eaſterly ones is well known, I believe, in every climate of the world; which may be thus explained, from the theory above delivered. 1. When the air is ſtill, the higher parts of the atmoſphere move quicker than thoſe parts which touch the earth, becauſe they are at a greater diſtance from the axis of motion. 2. The part of the atmoſphere where the north or ſouth wind comes from, is higher than the part of it where it comes to; hence the more elevated parts of the atmoſphere continue to deſcend towards the earth as either of thoſe winds approach. 3. When ſouthern air is brought to us it poſſeſſes a weſterly direction alſo, owing to the velocity it has previouſly acquired from the earth's ſurface; and if it conſiſts of air from the higher parts of the atmoſphere deſcending nearer the earth, this weſterly velocity becomes increaſed. But when northern air is brought to us, it poſſeſſes an apparent eaſterly direction alſo, owing to the velocity which it has previouſly acquired from the earth's ſurface being leſs than that of the earth's ſurface in this latitude: now, if the north-eaſt wind conſiſts of air deſcending from higher parts of the atmoſphere, this deficiency of velocity will be leſs, in conſequence of the ſame cauſe, viz. the higher parts of the atmoſphere deſcending, as the wind approaches, increaſes the real velocity of the weſtern winds, and decreaſes the apparent velocity of the eaſtern ones.

*October* 22. Wind changed from ſouth-eaſt to ſouth-weſt. There is a popular prognoſtication that if the wind changes from the north towards the ſouth, paſſing through the eaſt, it is more likely to continue in the ſouth, than if it paſſes through the weſt, which may be thus accounted for. If the north-eaſt wind changes to a north-weſt wind, it ſhews either that a part of the northern air deſcends upon us in a ſpiral eddy, or that a ſuperior current of ſouthern air is driven back; but if a north-eaſt wind be changed into a ſouth-eaſt wind, it ſhews that the northern air is become retrograde, and that in a day or two, as ſoon as that part of it has paſſed which has not gained the velocity of the earth's ſurface in this latitude, it will become a ſouth wind for a few hours, and then a ſouth-weſt wind.

The writer of this imperfect ſketch of anemology, wiſhes it may incite ſome perſon of greater leiſure and ability to attend to this ſubject, and by comparing the various meteorological journals and obſervations already publiſhed, to conſtruct a more accurate and methodical treatiſe on this intereſting branch of philoſophy.

## NOTE XXXIV.—VEGETABLE PERSPIRATION.

*And wed the enamour'd Oxygene to Light.* Canto IV. l. 34.

WHEN points or hairs are put into ſpring-water, as in the experiments of Sir B. Thompſon, (Phil. Tranſ. LXXVII.) and expoſed to the light of the ſun, much air, which looſely adhered to the water, riſes in bubbles, as explained in the note on Fucus, vol. II. A ſtill greater quantity of air, and of a purer kind, is emitted by Dr. Prieſtley's green matter, and by vegetable leaves growing in water in ſunſhine, according to Mr. Ingenhouz's experiments; both which I ſuſpect to be owing to a decompoſition of the water perſpired by the plant; for the edge of a capillary tube of great tenuity may be conſidered as a circle of points, and as the oxygene, or principle of vital air, may be expanded into a gas by the ſun's light, the hydrogene, or inflammable air, may be detained in the pores of the vegetable.

Hence plants growing in the ſhade are white, and become green by being expoſed to the ſun's light; for their natural colour being blue, the addition of hydrogene adds yellow to this blue, and *tans* them green. I ſuppoſe a ſimilar circumſtance takes place in animal bodies; their perſpirable matter, as it eſcapes in the ſunſhine, becomes decompoſed by the edges of their pores, as in vegetables, though in leſs quantity, as their perſpiration is leſs, and by their hydrogene being retained the ſkin becomes *tanned* yellow. In proof of this it muſt be obſerved, that both vegetable and animal ſubſtances become bleached white by the ſun-beams when they are dead, as cabbage-ſtalks, bones, ivory, tallow, bees-wax, linen and cotton cloth; and hence, I ſuppoſe, the copper-coloured natives of ſunny countries might become etiolated, or blanched, by being kept from their infancy in the dark, or removed, for a few generations, to more northerly climates.

It is probable that on a ſunny morning much pure air becomes ſeparated from the dew, by means of the points of vegetables, on which it adheres, and much inflammable air imbibed by the vegetable, or combined with it; and by the ſun's light thus decompoſing water, the effects of it in bleaching linen ſeems to depend (as deſcribed in note X.): the water is decompoſed by the light at the ends or points of the cotton or thread, and the vital air unites with the phlogiſtic or colouring matters of the cloth, and produces a new acid, which is either itſelf colourleſs, or waſhes out; at the ſame time the inflammable part of the water eſcapes. Hence there ſeems a reaſon why cotton bleaches ſo much ſooner than linen, viz. becauſe its fibres are three or four times ſhorter, and therefore protrude ſo many more points, which ſeem to facilitate the liberation of the vital air from the inflammable part of the water.

Bees-wax becomes bleached by expoſure to the ſun and dews, in a ſimilar manner as metals become calcined or ruſty, viz. by the water on their ſurface being decompoſed; and hence the inflammable material, which cauſed the colour, becomes united with vital air, forming a new acid, and is waſhed away.

Oil, cloſe ſtopped in a phial not full, and expoſed long to the ſun's light, becomes bleached, as I ſuppoſe, by the decompoſition of the water it contains; the inflammable air riſing above the ſurface, and the vital air uniting with the colouring matter of the oil. For it is remarkable, that by ſhutting up a phial of bleached oil in a dark drawer, it, in a little time, becomes coloured again.

The following experiment ſhews the power of light in ſeparating vital air from another baſis, viz. from azote. Mr. Scheele inverted a glaſs veſſel, filled with colourleſs nitrous acid, into another glaſs, containing the ſame acid, and, on expoſing them to the ſun's light, the inverted glaſs became partly filled with pure air, and the acid, at the ſame time, became coloured. Scheele, in Crell's Annal. 1786. But if the veſſel of colourleſs nitrous acid be quite full, and ſtopped, ſo that no ſpace is left for the air produced to expand itſelf into, no change of colour takes place. Prieſtley's Exp. VI. p. 344. See Keir's very excellent Chemical Dictionary, p. 99. new edition.

A ſun-flower, three feet and a half high, according to the experiment of Dr. Hales, perſpired two pints in one day (Vegetable Statics), which is many times as much, in proportion to its ſurface, as is perſpired from the ſurface and lungs of animal bodies; it follows, that the vital air liberated from the ſurfaces of plants by the ſunſhine, muſt much exceed the quantity of it abſorbed by their reſpiration, and that hence they improve the air in which they live during the light part of the day; and thus blanched vegetables will ſooner become *tanned into green* by the ſun's light, than etiolated animal bodies will become *tanned yellow* by the ſame means.

It is hence evident, that the curious diſcovery of Dr. Prieſtley, that his green vegetable matter, and other aquatic plants, gave out vital air when the ſun ſhone upon them, and the leaves of other plants did the ſame when immerſed in water, as obſerved by Mr. Ingenhouz, refer to the perſpiration of vegetables, not to their reſpiration. Becauſe Dr. Prieſtley obſerved the pure air to come from both ſides of the leaves, and even from the ſtalks of a water-flag, whereas one ſide of the leaf only ſerves the office of lungs, and certainly not the ſtalks. Exper. on Air, vol. III. And thus, in reſpect to the circumſtance in which plants and animals ſeemed the fartheſt removed from each other, I mean in their ſuppoſed mode of reſpiration, by which one was believed to purify the air which the other had injured, they ſeem to differ only in degree, and the analogy between them remains unbroken.

Plants are ſaid, by many writers, to grow much faſter in the night than in the day, as is particularly obſervable in ſeedlings, at their riſing out of the ground. This probably is a conſequence of their ſleep rather than of the abſence of light; and in this, I ſuppoſe, they alſo reſemble animal bodies.

## NOTE XXXV.—VEGETABLE PLACENTATION.

*While in bright veins the ſilvery Sap aſcends.* CANTO IV. l. 431.

AS buds are the viviparous offspring of vegetables, it becomes neceſſary that they ſhould be furniſhed with placental veſſels for their nouriſhment, till they acquire lungs, or leaves, for the purpoſe of elaborating the common juices of the earth into nutriment. Theſe veſſels exiſt in bulbs and in ſeeds, and ſupply the young plant with a ſweet juice, till it acquires leaves, as is ſeen in converting barley into malt, and appears from the ſweet taſte of onions and potatoes, when they begin to grow.

The placental veſſels belonging to the buds of trees are placed about the roots of moſt, as the vine; ſo many roots are furniſhed with ſweet or mealy matter, as fern-root, bryony, carrot, turnip, potatoe, or in the alburnum, or ſap-wood, as in thoſe trees which produce manna, which is depoſited about the month of Auguſt, or in the joints of ſugar-cane, and graſſes; early in the ſpring the abſorbent mouths of theſe veſſels drink up moiſture from the earth, with a ſaccharine matter lodged for that purpoſe during the preceding autumn, and puſh this nutritive fluid up the veſſels of the alburnum, to every individual bud, as is evinced by the experiments of Dr. Hales, and of Mr. Walker, in the Edinburgh Philoſophical Tranſ. The former obſerved, that the ſap from the ſtump of a vine, which he had cut off in the beginning of April, aroſe twenty-one feet high, in tubes affixed to it for that purpoſe; but in a few weeks it ceaſed to bleed at all, and Dr. Walker marked the progreſs of the aſcending ſap, and found likewiſe that as ſoon as the leaves became expanded, the ſap ceaſed to riſe: the aſcending juice of ſome trees is ſo copious and ſo ſweet during the ſap-ſeaſon, that it is uſed to make wine, as the birch, betula, and ſycamore, acer pſeudo-platanus, and particularly the palm, and maple acer.

During this aſcent of the ſap-juice, each individual leaf-bud expands its new leaves, and ſhoots down new roots, covering, by their intermixture, the old bark with a new one; and as ſoon as theſe new roots (or bark) are capable of abſorbing ſufficient juices from the earth for the ſupport of each bud, and the new leaves are capable of performing their office of expoſing theſe juices to the influence of the air, the placental veſſels ceaſe to act, coaleſce, and are transformed from ſap-wood, or alburnum, into inert wood, ſerving only for the ſupport of the new tree, which grows over them.

Thus from the pith of the new bud of the horſe-cheſnut five veſſels paſs out through the circle of the placental veſſels above deſcribed, and carry with them a minuter circle of thoſe veſſels; theſe five bundles of veſſels unite after their exit, and form the foot-ſtalk or petiole of the new five-fingered leaf, to be ſpoken of hereafter. This ſtructure is well ſeen by cutting off a leaf of the horſe-cheſnut (Æſculus Hippocaſtanum) in September, before it falls, as the buds of this tree are ſo large that the flower may be ſeen in them with the naked eye.

After a time, perhaps about midſummer, another bundle of veſſels paſſes from the pith through the alburnum, or ſap-veſſels, in the boſom of each leaf, and unites, by the new bark, with the leaf, which becomes either a flower-bud or leaf-bud, to be expanded in the enſuing ſpring, for which purpoſe an apparatus of placental veſſels is produced, with proper nutriment, during the progreſs of the ſummer and autumn; and thus the vegetable becomes annually increaſed, ten thouſand buds often exiſting on one tree, according to the eſtimate of Linnæus. Phil. Bot.

The vaſcular connection of vegetable buds with the leaves in whoſe boſoms they are formed, is confirmed by the following experiment, (Oct. 10, 1781.) On the extremity of a young bud of the Mimoſa (ſenſitive plant) a ſmall drop of acid of vitriol was put, by means of a pen, and, after a few ſeconds, the leaf in whoſe axilla it dwelt cloſed, and opened no more, though the drop of vitriolic acid was ſo ſmall as apparently only to injure the ſummit of the bud. Does not this ſeem to ſhew that the leaf and its bud have connecting veſſels, though they ariſe at different times, and from different parts of the medulla, or pith? And, as it exiſts previouſly to it, that the leaf is the parent of the bud?

This placentation of vegetable buds is clearly evinced from the ſweetneſs of the riſing ſap, and from its ceaſing to riſe as ſoon as the leaves are expanded, and thus completes the analogy between buds and bulbs. Nor need we wonder at the length of the umbilical cords of buds, ſince that muſt correſpond with their ſituation on the tree, in the ſame manner as their lymphatics and arteries are proportionally elongated.

It does not appear probable that any umbilical artery attends theſe placental abſorbents, ſince, as there ſeems to be no ſyſtem of veins in vegetables to bring back the blood from the extremities of their arteries (except their pulmonary veins), there could not be any vegetable fluids to be returned to their placenta, which, in vegetables, ſeems to be ſimply an organ for nutrition, whereas the placenta of the animal fœtus ſeems likewiſe to ſerve as a reſpiratory organ, like the gills of fiſhes.

## NOTE XXXVI.—VEGETABLE CIRCULATION.

*And refluent blood in milky eddies bends.* Canto IV. l. 432.

THE individuality of vegetable buds was ſpoken of before, and is confirmed by the method of raiſing all kinds of trees, by Mr. Barnes. (Method of propagating Fruit Trees. 1759. Lond. Baldwin.) He cut a branch into as many pieces as there were buds or leaves upon it, and wiping the two wounded ends dry, he quickly applied to each a cement, previouſly warmed a little, which conſiſted principally of pitch, and planted them in the earth. The uſe of this cement I ſuppoſe to conſiſt in its preventing the bud from bleeding to death, though the author aſcribes it to its antiſeptic quality.

Theſe buds of plants, which are thus each an individual vegetable, in many circumſtances reſemble individual animals; but as animal bodies are detached from the earth, and move from place to place in ſearch of food, and take that food at conſiderable intervals of time, and prepare it for their nouriſhment within their own bodies after it is taken, it is evident they muſt require many organs and powers which are not neceſſary to a ſtationary bud. As vegetables are immoveably fixed to the ſoil from whence they draw their nouriſhment ready prepared, and this uniformly, not at returning intervals, it follows, that in examining their anatome, we are not to look for muſcles of locomotion, as arms and legs; nor for organs to receive and prepare their nouriſhment, as a ſtomach and bowels; nor for a reſervoir for it after it is prepared, as a general ſyſtem of veins, which, in locomotive animals, contains and returns the ſuperfluous blood which is left after the various organs of ſecretion have been ſupplied, by which contrivance they are enabled to live a long time without new ſupplies of food.

The parts which we may expect to find in the anatome of vegetables, correſpondent to thoſe in the animal economy, are, 1. A ſyſtem of abſorbent veſſels, to imbibe the moiſture of the earth ſimilar to the lacteal veſſels, as in the roots of plants; and another ſyſtem of abſorbents, ſimilar to the lymphatics of animal bodies, opening its mouths on the internal cells and external ſurfaces of vegetables; and a third ſyſtem of abſorbent veſſels, correſpondent with thoſe of the placentation of the animal fœtus. 2. A pulmonary ſyſtem, correſpondent to the lungs or gills of quadrupeds and fiſh, by which the fluid abſorbed by the lacteals and lymphatics may be expoſed to the influence of the air: this is done by the green leaves of plants, thoſe in the air reſembling lungs, and thoſe in the water reſembling gills; and by the petals of flowers. 3. Arterial ſyſtems to convey the fluid thus elaborated to the various glands of the vegetable, for the purpoſes of its growth, nutrition, and various ſecretions. 4. The various glands which ſeparate from the vegetable blood the honey, wax, gum, reſin, ſtarch, ſugar, eſſential oil, &c. 5. The organs adapted for their propagation or reproduction. 6. Muſcles to perform ſeveral motions of their parts.

I. The exiſtence of that branch of the abſorbent veſſels of vegetables which reſembles the lacteals of animal bodies, and imbibes their nutriment from the moiſt earth, is evinced by their growth ſo long as moiſture is applied to their roots, and their quickly withering when it is withdrawn,

Beſides theſe abſorbents in the roots of plants there are others, which open their mouths on the external ſurfaces of the bark and leaves, and on the internal ſurfaces of all the cells, and between the bark and the alburnum, or ſap-wood; the exiſtence of theſe is ſhewn, becauſe a leaf plucked off, and laid with its under ſide on water, will not wither ſo ſoon as if left in the dry air,—the ſame if the bark alone of a branch which is ſeparated from a tree be kept moiſt with water,—and, laſtly, by moiſtening the alburnum or ſap-wood alone of a branch detached from a tree, it will not ſo ſoon wither as if left in the dry air. By the following experiment theſe veſſels were agreeably viſible by a common magnifying glaſs: I placed, in the ſummer of 1781, the foot-ſtalks of ſome large fig-leaves about an inch deep in a decoction of madder (rubia tinctorum) and others in a decoction of logwood (hæmatoxylum campechenſe), along with ſome ſprigs cut off from a plant of picris; theſe plants were choſen becauſe their blood is white; after ſome hours, and on the next day, on taking out either of theſe, and cutting off from its bottom about a quarter of an inch of the ſtalk, an internal circle of red points appeared, which were the ends of abſorbent veſſels, coloured red with the decoction, while an external ring of arteries was ſeen to bleed out haſtily a milky juice, and, at once, evinced both the abſorbent and arterial ſyſtem. Theſe abſorbent veſſels have been called by Grew, and Malphigi, and ſome other philoſophers, bronchi, and erroneouſly ſuppoſed to be air-veſſels. It is probable that theſe veſſels, when cut through, may effuſe their fluids, and receive air, their ſides being too ſtiff to collapſe; ſince dry wood emits air-bubbles in the exhauſted receiver in the ſame manner as moiſt wood.

The ſtructure of theſe vegetable abſorbents conſiſts of a ſpiral line, and not of a veſſel interrupted with valves like the animal lymphatics, ſince on breaking almoſt any tender leaf, and drawing out ſome of the fibres, which adhere longeſt, this ſpiral ſtructure becomes viſible, even to the naked eye, and diſtinctly ſo by the uſe of a common lens. See Grew, plate 51.

In ſuch a ſtructure it is eaſy to conceive how a vermicular or periſtaltic motion of the veſſel, beginning at the loweſt part of it, each ſpiral ring ſucceſſively contracting itſelf till it fills up the tube, muſt forcibly puſh forwards its contents, as from the roots of vines in the bleeding ſeaſon; and if this vermicular motion ſhould begin at the upper end of the veſſel, it is as eaſy to ſee how it muſt carry its contained fluid in a contrary direction. The retrograde motion of the vegetable abſorbent veſſels is ſhewn by cutting a forked branch from a tree, and immerſing a part of one of the forks in water, which will, for many days, prevent the other from withering; or, it is ſhewn by planting a willow branch with the wrong end upwards. This ſtructure, in ſome degree, obtains in the œſophagus, or throat of cows, who, by ſimilar means, convey their food firſt downwards, and afterward upwards, by a retrograde motion of the annular muſcles, or cartilages, for the purpoſe of a ſecond maſtication of it.

II. The fluids thus drank up by the vegetable abſorbent veſſels from the earth, or from the atmoſphere, or from their own cells and interſtices, are carried to the foot-ſtalk of every leaf, where the abſorbents belonging to each leaf unite into branches, forming ſo many pulmonary arteries, and are thence diſperſed to the extremities of the leaf, as may be ſeen in cutting away, ſlice after ſlice, the foot-ſtalk of a horſe-cheſnut in September, before the leaf falls. There is then a complete circulation in the leaf; a pulmonary vein receiving the blood from the extremities of each artery, on the upper ſide of the leaf, and joining again in the foot-ſtalk of the leaf, theſe veins produce ſo many arteries, or aortas, which diſperſe the new blood over the new bark, elongating its veſſels, or producing its ſecretions; but as a reſervoir of blood could not be wanted by a vegetable bud which takes in its nutriment at all times, I imagine there is no venous ſyſtem, no veins, properly ſo called, which receive the blood which was to ſpare, and return it into the pulmonary or arterial ſyſtem.

The want of a ſyſtem of veins was countenanced by the following experiment: I cut off ſeveral ſtems of tall ſpurge (Euphorbia helioſcopia) in autumn, about the centre of the plant, and obſerved tenfold the quantity of milky juice ooze from the upper than from the lower extremity, which could hardly have happened if there had been a venous ſyſtem of veſſels to return the blood from the roots to the leaves.

Thus the vegetable circulation, complete in the lungs, but, probably, in the other part of the ſyſtem deficient, in reſpect to a ſyſtem of returning veins, is carried forwards without a heart, like the circulation through the livers of animals, where the blood brought from the inteſtines and meſentery by one vein, is diſperſed through the liver by the vena portarum, which aſſumes the office of an artery. See note XXXVII.

At the ſame time ſo minute are the veſſels in the intertexture of the barks of plants, which belong to each individual bud, that a general circulation may poſſibly exiſt, though we have not yet been able to diſcover the venous part of it.

There is, however, another part of the circulation of vegetable juices viſible to the naked eye, and that is in the corol or petals of flowers, in which a part of the blood of the plant is expoſed to the influence of the air and light in the ſame manner as in the foliage, as will be mentioned more at large in notes XXXVII and XXXIX.

Theſe circulations of their reſpective fluids ſeem to be carried on in the veſſels of plants preciſely as in animal bodies, by their irritability to the ſtimulus of their adapted fluids, and not by any mechanical or chemical attraction, for their abſorbent veſſels propel the juice upwards, which they drink up from the earth, with great violence; I ſuppoſe with much greater than is exerted by the lacteals of animals, probably owing to the greater minuteneſs of theſe veſſels in vegetables, and the greater rigidity of their coats. Dr. Hales, in the ſpring ſeaſon, cut off a vine near the ground, and, by fixing tubes on the remaining ſtump of it, found the ſap to riſe twenty-one feet in the tube, by the propulſive power of theſe abſorbents of the roots of it. Veget. Stat. p. 102. Such a power cannot be produced by capillary attraction, as that could only raiſe a fluid nearly to the upper edge of the attracting cylinder, but not enable it to flow over that edge, and much leſs to riſe 21 feet above it. What then can this power be owing to? Doubtleſs to the living activity of the abſorbent veſſels, and to their increaſed vivacity, from the influence of the warmth of the ſpring ſucceeding the winter's cold, and their thence greater ſuſceptibility to irritation from the juices which they abſorb, reſembling, in all circumſtances, the action of the living veſſels of animals.

## NOTE XXXVII.—VEGETABLE RESPIRATION.

*While, ſpread in air, the leaves reſpiring play.* CANTO IV. l. 433.

I. THERE have been various opinions concerning the uſe of the leaves of plants in the vegetable economy. Some have contended that they are perſpiratory organs; this does not ſeem probable from an experiment of Dr. Hales. Veget. Stat. p. 30. He found, by cutting off branches of trees with apples on them, and taking off the leaves, that an apple exhaled about as much as two leaves, the ſurfaces of which were nearly equal to the apple; whence it would appear that apples have as good a claim to be termed perſpiratory organs as leaves. Others have believed them excretory organs of excrementitious juices; but as the vapour exhaled from vegetables has no taſte, this idea is no more probable than the other; add to this, that in moiſt weather they do not appear to perſpire or exhale at all.

The internal ſurface of the lungs or air-veſſels in men, is ſaid to be equal to the external ſurface of the whole body, or about fifteen ſquare feet; on this ſurface the blood is expoſed to the influence of the reſpired air, through the medium, however, of a thin pellicle; by this expoſure to the air it has its colour changed from deep red to bright ſcarlet, and acquires ſomething ſo neceſſary to the exiſtence of life, that we can live ſcarcely a minute without this wonderful proceſs.

The analogy between the leaves of plants and the lungs or gills of animals, ſeems to embrace ſo many circumſtances, that we can ſcarcely withhold our aſſent to their performing ſimilar offices.

1. The great ſurface of the leaves, compared to that of the trunk and branches of trees, is ſuch, that it would ſeem to be an organ well adapted for the purpoſe of expoſing the vegetable juices to the influence of the air; this, however, we ſhall ſee afterwards, is probably performed only by their upper ſurfaces; yet even in this caſe the ſurface of the leaves in general bears a greater proportion to the ſurface of the tree, than the lungs of animals to their external ſurfaces.

2. In the lungs of animals, the blood, after having been expoſed to the air in the extremities of the pulmonary artery, is changed in colour from deep red to bright ſcarlet, and certainly in ſome of its eſſential properties; it is then collected by the pulmonary vein, and returned to the heart. To ſhew a ſimilarity of circumſtances in the leaves of plants, the following experiment was made, June 24, 1781. A ſtalk, with leaves and ſeed-veſſels, of large

ſpurge (Euphorbia helioſcopia) had been ſeveral days placed in a decoction of madder (Rubia tinctorum), ſo that the lower part of the ſtem, and two of the undermoſt leaves, were immerſed in it. After having waſhed the immerſed leaves in clear water, I could readily diſcern the colour of the madder paſſing along the middle rib of each leaf. This red artery was beautifully viſible both on the under and upper ſurface of the leaf; but on the upper ſide many red branches were ſeen going from it to the extremities of the leaf, which, on the other ſide, were not viſible, except by looking through it againſt the light. On this under ſide a ſyſtem of branching veſſels, carrying a pale milky fluid, were ſeen coming from the extremities of the leaf, and covering the whole under ſide of it, and joining into two large [illegible]ns, one on each ſide of the red artery, in the middle rib of the leaf, and along with it deſcending to the foot-ſtalk or petiole. On ſlitting one of theſe leaves with ſciſſars, and having a common magnifying lens ready, the milky blood was ſeen oozing out of the returning veins on each ſide of the red artery, in the middle rib, but none of the red fluid from the artery.

All theſe appearances were more eaſily ſeen in a leaf of picris treated in the ſame manner; for in this milky plant the ſtems and middle rib of the leaves are ſometimes naturally coloured reddiſh, and hence the colour of the madder ſeemed to paſs further into the ramifications of their leaf-arteries, and was there beautifully viſible, with the returning branches of milky veins on each ſide.

3. From theſe experiments, the upper ſurface of the leaf appeared to be the immediate organ of reſpiration, becauſe the coloured fluid was carried to the extremities of the leaf by veſſels moſt conſpicuous on the upper ſurface, and there changed into a milky fluid, which is the blood of the plant, and then returned, by concomitant veins, on the under ſurface, which were ſeen to ooze when divided with ſciſſars, and which, in picris particularly, render the under ſurface of the leaves greatly whiter than the upper one.

4. As the upper ſurface of leaves conſtitutes the organ of reſpiration, on which the ſap is expoſed, in the terminations of arteries, beneath a thin pellicle, to the action of the atmoſphere, theſe ſurfaces, in many plants, ſtrongly repel moiſture, as cabbage-leaves; whence the particles of rain lying over their ſurfaces without touching them, as obſerved by Mr. Melville (Eſſays Literary and Philoſoph. Edinburgh), have the appearance of globules of quick-ſilver. And hence leaves, laid with the upper ſurfaces on water, wither as ſoon as in the dry air, but continue green many days if placed with the under ſurfaces on water, as appears in the experiments of Monſ. Bonnet (Uſage des Feuilles). Hence ſome aquatic plants, as the water-lily (Nymphœa), have the lower ſides of their leaves floating on the water, while the upper ſurfaces remain dry in the air.

5. As thoſe inſects which have many ſpiracula, or breathing apertures, as waſps and flies, are immediately ſuffocated by pouring oil upon them, I carefully covered with oil the ſurfaces of ſeveral leaves of Phlomis, of Portugal Laurel, and Balſams; and though it would not regularly adhere, I found them all die in a day or two.

Of aquatic leaves, ſee note on Trapa and on Fucus, in vol II. to which muſt be added, that many leaves are furniſhed with muſcles about their foot-ſtalks, to turn their upper ſurfaces to the air or light, as Mimoſa and Hedyſarum gyrans. From all theſe analogies, I think there can be no doubt but that leaves of trees are their lungs, giving out a phlogiſtic material to the atmoſphere, and abſorbing oxygene or vital air.

6. The great uſe of light to vegetation would appear, from this theory, to be, by diſengaging vital air from the water which they perſpire, and thence to facilitate its union with their blood, expoſed beneath the thin ſurface of their leaves; ſince, when pure air is thus applied, it is probable that it can be more readily abſorbed. Hence, in the curious experiments of Dr. Pr[illegible]ey and Mr. Ingenhouz, ſome plants purified air leſs than others, that is, they perſpired leſs in the ſunſhine; and Mr. Scheele found, that by putting peas into water which about half covered them, they converted the vital air into fixed air, or carbonic acid gas, in the ſame manner as in animal reſpiration. See note XXXIV.

7. The circulation in the lungs or leaves of plants is very ſimilar to that of fiſh. In fiſh, the blood, after having paſſed through their gills, does not return to the heart, as from the lungs of air-breathing animals, but the pulmonary vein, taking the ſtructure of an artery, after having received the blood from the gills, which there gains a more florid colour, diſtributes it to the other parts of their bodies. The ſame ſtructure occurs in the livers of fiſh, whence we ſee, in thoſe animals, two circulations independent of the power of the heart, viz. that beginning at the termination of the veins of the gills, and branching through the muſcles, and that which paſſes through the liver; both which are carried on by the action of thoſe reſpective arteries and veins. Monro's Phyſiology of Fiſh, p. 19.

The courſe of the fluids in the roots, leaves, and buds of vegetables, ſeems to be performed in a manner ſimilar to both theſe. Firſt the abſorbent veſſels of the roots and ſurfaces unite at the foot-ſtalk of the leaf, and then, like the vena portarum, an artery commences without the intervention of a heart, and ſpreads the ſap, in its numerous ramifications, on the upper ſurface of the leaf: here it changes its colour and properties, and becomes vegetable blood; and is again collected by a pulmonary vein on the under ſurface of the leaf. This vein, like that which receives the blood from the gills of fiſh, aſſumes the office and name of an artery, and, branching again, diſperſes the blood upward to the bud, from the foot-ſtalk of the leaf, and downward to the roots; where it is all expended in the various ſecretions, the nouriſhment and growth of the plant, as faſt as it is prepared.

II. The organ of reſpiration already ſpoken of belongs particularly to the ſhoots or buds; but there is another pulmonary ſyſtem, perhaps totally independent of the green foliage, which belongs to the fructification only; I mean the corol or petals. In this there is an artery belonging to each petal, which conveys the vegetable blood to its extremities, expoſing it to the light and air under a delicate membrane, covering the internal ſurface of the petal, where it often changes its colour, as is beautifully ſeen in ſome party-coloured poppies; though it is probable ſome of the irideſcent colours of flowers may be owing to the different degrees of tenuity of the exterior membrane of the leaf, refracting the light like ſoap-bubbles; the vegetable blood is then returned by correſpondent vegetable veins, exactly as in the green foliage; for the purpoſes of the important ſecretions of honey, wax, the finer eſſential oil, and the prolific duſt of the anthers.

1. The vaſcular ſtructure of the corol, as above deſcribed, and which is viſible to the naked eye, and its expoſing the vegetable juices to the air and light during the day, evinces that it is a pulmonary organ.

2. As the glands which produce the prolific duſt of the anthers, the honey, wax, and frequently ſome odoriferous eſſential oil, are generally attached to the corol, and always fall off, and periſh with it, it is evident that the blood is elaborated or oxygenated in this pulmonary ſyſtem, for the purpoſe of theſe important ſercretions.

3. Many flowers, as the Colchicum, and Hamamelis, ariſe naked in autumn, no green leaves appearing till the enſuing ſpring; and many others put forth their flowers, and complete their impregnation, early in the ſpring, before the green foliage appears, as Mezerion, cherries, pears, which ſhews that theſe corols are the lungs belonging to the fructification.

4. This organ does not ſeem to have been neceſſary for the defence of the ſtamens and piſtils, ſince the calyx of many flowers, as Tragopogon, performs this office; and, in many flowers, theſe petals themſelves are ſo tender as to require being ſhut up in the calyx during the night; for what other uſe then can ſuch an apparatus of veſſels be deſigned?

5. In the Helleborus niger, Chriſtmas-roſe, after the ſeeds are grown to a certain ſize, the nectaries and ſtamens drop off, and the beautiful large white petals change their colour to a deep green, and gradually thus become a calyx, incloſing and defending the ripening ſeeds; hence it would ſeem that the white veſſels of the corol ſerved the office of expoſing the blood to the action of the air, for the purpoſes of ſeparating or producing the honey, wax, and prolific duſt; and when theſe were no longer wanted, that theſe veſſels coaleſced like the placental veſſels of animals, after their birth, and thus ceaſed to perform that office, and loſt, at the ſame time, their white colour. Why ſhould they loſe their white colour, unleſs they, at the ſame time, loſt ſome other property beſides that of defending the ſeed-veſſel, which they ſtill continue to defend?

6. From theſe obſervations I am led to doubt whether green leaves be abſolutely neceſſary to the progreſs of the fruit-bud, after the laſt year's leaves are fallen off. The green leaves ſerve as lungs to the ſhoots, and foſter the new buds in their boſoms, whether theſe buds be leaf-buds or fruit-buds; but in the early ſpring the fruit-buds expand their corols, which are their lungs, and ſeem no longer to require green leaves; hence the vine bears fruit at one joint without leaves, and puts out a leaf-bud at another joint without fruit. And, I ſuppoſe, the green leaves which riſe out of the earth, in the ſpring, from the Colchicum, are for the purpoſe of producing the new bulb and its placenta, and not for the giving maturity to the ſeed. When currant or gooſberry trees loſe their leaves by the depredation of inſects, the fruit ſtill continues to be formed, though leſs ſweet and leſs in ſize.

7. From theſe facts it appears, that the flower-bud, after the corol falls off (which is its lungs), and the ſtamens and nectary along with it, becomes ſimply an uterus for the purpoſe of ſupplying the growing embryon with nouriſhment, together with a ſyſtem of abſorbent veſſels, which bring the juices of the earth to the foot-ſtalk of the fruit, and which there changes into an artery, for the purpoſe of diſtributing the ſap for the ſecretion of the ſaccharine, or farinaceous, or aceſcent materials, for the uſe of the embryon. At the ſame time as all the veſſels of the different buds of trees inoſculate or communicate with each other, the fruit becomes ſweeter and larger when the green leaves continue on the tree, but the mature flowers themſelves (the ſucceeding fruit not conſidered), perhaps ſuffer little injury from the green leaves being taken off, as ſome floriſts have obſerved.

8. That the veſſels of different vegetable buds inoſculate in various parts of their circulation, is rendered probable by the increaſed growth of one bud, when others in its vicinity are cut away; as it thus ſeems to receive the nouriſhment which was before divided amongſt many.

## NOTE XXXVIII.—VEGETABLE IMPREGNATION.

*Love out his hour, and leave his life in air.* CANTO IV. l. 472.

FROM the accurate experiments and obſervations of Spallanzani, it appears, that in the Spartium Junceum, ruſh-broom, the very minute ſeeds were diſcerned in the pod at leaſt twenty days before the flower is in full bloom, that is, twenty days before fecundation. At this time alſo the powder of the anthers was viſible, but glued faſt to their ſummits. The ſeeds, however, at this time, and for ten days after the bloſſom had fallen off, appeared to conſiſt of a gelatinous ſubſtance. On the eleventh day after the falling of the bloſſom, the ſeeds became heart-ſhape, with the baſis attached by an appendage to the pod, and a white point at the apex; this white point was, on preſſure, found to be a cavity including a drop of liquor.

On the 25th day, the cavity, which at firſt appeared at the apex, was much enlarged, and ſtill full of liquor; it alſo contained a very ſmall ſemitranſparent body, of a yellowiſh colour, gelatinous, and fixed by its two oppoſite ends to the ſides of the cavity.

In a month the ſeed was much enlarged, and its ſhape changed from a heart to a kidney; the little body contained in the cavity was increaſed in bulk, and was leſs tranſparent and gelatinous, but there yet appeared no organization.

On the 40th day, the cavity, now grown larger, was quite filled with the body, which was covered with a thin membrane; after this membrane was removed, the body appeared of a bright green, and was eaſily divided, by the point of a needle, into two portions, which manifeſtly formed the two lobes, and within theſe, attached to the lower part, the exceedingly ſmall plantule was eaſily perceived.

The foregoing obſervations evince, 1. That the ſeeds exiſt in the ovarium many days before fecundation. 2. That they remain for ſome time ſolid, and then a cavity, containing a liquid, is formed in them. 3. That after fecundation a body begins to appear within the cavity, fixed by two points to the ſides, which, in proceſs of time, proves to be two lobes containing a plantule. 4. That the ripe ſeed conſiſts of two lobes adhering to a plantule, and ſurrounded by a thin membrane, which is itſelf covered with a huſk or cuticle. Spallanzani's Diſſertations, vol. II. p. 253.

The analogy between ſeeds and eggs has long been obſerved, and is confirmed by the mode of their production. The egg is known to be formed within the hen long before its impregnation. C. F. Wolf aſſerts, that the yolk of the egg is nouriſhed by the veſſels of the mother, and that it has from thoſe its arterial and venous branches, but that after impregnation theſe veſſels gradually become impervious and obliterated, and that new ones are produced from the fœtus, and diſperſed into the yolk. Haller's Phyſiolog. Tom. VIII. p. 94. The young ſeed, after fecundation, I ſuppoſe, is nouriſhed in a ſimilar manner, from the gelatinous liquor, which is previouſly depoſited for that purpoſe; the uterus of the plant producing or ſecreting it into a reſervoir or amnios, in which the embryon is lodged, and that the young embryon is furniſhed with veſſels to abſorb a part of it, as in the very early embryon in the animal uterus.

The ſpawn of frogs and of fiſh is delivered from the female before its impregnation. M. Bonnet ſays, that the male ſalamander darts his ſemen into the water, where it forms a little whitiſh cloud, which is afterwards received by the ſwoln anus of the female, and ſhe is fecundated.—He adds, that marine plants approach near to theſe animals, as the male does not project a fine powder, but a liquor, which, in like manner, forms a little cloud in the water.—And further adds, who knows but the powder of the ſtamina of certain plants may make ſome impreſſion on certain germs belonging to the animal kingdom! Letter XLIII. to Spallanzani, Oeuvres Philoſ.

Spallanzani found that the ſeminal fluid of frogs and dogs, even when diluted with much water, retained its prolific quality. Whether this quality be ſimply a ſtimulus exciting the egg into animal action, which may be called a vivifying principle, or whether part of it be actually conjoined with the egg, is not yet determined, though the latter ſeems more probable, from the frequent reſemblance of the fœtus to the male parent. A conjunction, however, of both the male and female influence ſeems neceſſary for the purpoſe of reproduction throughout all organized nature, as well in hermaphrodite inſects, microſcopic animals, and polypi, and exiſts as well in the formation of the buds of vegetables, as in the production of their ſeeds, which is ingeniouſly conceived and explained by Linnæus. After having compared the flower to the larva of a butterfly, conſiſting of petals inſtead of wings, calyxes inſtead of wing-ſheaths, with the organs of reproduction; and having ſhewn the uſe of the farina in fecundating the egg or ſeed, he proceeds to explain the production of the bud. The calyx of a flower, he ſays, is an expanſion of the outer bark; the petals proceed from the inner bark, or rind, the ſtamens from the alburnum, or woody circle, and the ſtyle from the pith. In the production and impregnation of the ſeed, a commixture of the ſecretions of the ſtamens and ſtyle are neceſſary; and for the production of a bud, he thinks the medulla, or pith, burſts its integuments, and mixes with the woody part, or alburnum, and theſe, forcing their paſſage through the rind and bark, conſtitute the bud, or viviparous progeny of the vegetable. Syſtem of Vegetables tranſlated from Linnæus, p. 8.

It has been ſuppoſed that the embryon vegetable, after fecundation, by its living activity, or ſtimulus exerted on the veſſels of the parent plant, may produce the fruit or ſeed-lobes, as the animal fœtus produces its placenta, and as vegetable buds may be ſuppoſed to produce their umbilical veſſels or roots, down the bark of the tree. This, in reſpect to the production of the fruit ſurrounding the ſeeds of trees, has been aſſimilated to the gall-nuts on oak-leaves, and to the bedeguar on briars; but there is a powerful objection to this doctrine, viz. that the fruit of figs, all which are female in this country, grow nearly as large without fecundation, and, therefore, the embryon has in them no ſelf-living principle.

## NOTE XXXIX.—VEGETABLE GLANDULATION.

*Seeks, where fine pores their dulcet balm diſtil.* Canto IV. l. 533.

THE glands of vegetables, which ſeparate from their blood the mucilage, ſtarch, or ſugar, for the placentation or ſupport of their ſeeds, bulbs, and buds; or thoſe which depoſit their bitter, acrid, or narcotic juices for their defence from depredations of inſects or larger animals; or thoſe which ſecrete reſins or wax for their protection from moiſture or froſts, conſiſt of veſſels too fine for the injection or abſorption of coloured fluids, and have not, therefore, yet been exhibited to the inſpection even of our glaſſes, and can, therefore, only be known by their effects; but one of the moſt curious and important of all vegetable ſecretions, that of honey, is apparent to our naked eyes, though, before the diſcoveries of Linnæus, the nectary, or honey-gland, had not even acquired a name.

The odoriferous eſſential oils of ſeveral flowers ſeem to have been deſigned for their defence againſt the depredations of inſects, while their beautiful colours were a neceſſary conſequence of the ſize of the particles of their blood, or of the tenuity of the exterior membrane of the petal. The uſe of the prolific duſt is now well aſcertained; the wax which covers the anthers prevents this duſt from receiving moiſture, which would make it burſt prematurely, and thence prevent its application to the ſtigma, as ſometimes happens in moiſt years, and is the cauſe of deficient fecundation, both of our fields and orchards.

The univerſality of the production of honey in the vegetable world, and the very complicated apparatus which natnre has conſtructed in many flowers, as well as the acrid or deleterious juices ſhe has furniſhed thoſe flowers with (as in the Aconite) to protect this honey from rain, and from the depredations of inſects, ſeem to imply that this fluid is of very great importance in the vegetable economy; and alſo, that it was neceſſary to expoſe it to the open air previous to its re-abſorption into the vegetable veſſels.

In the animal ſyſtem the lachrymal gland ſeparates its fluid into the open air, for the purpoſe of moiſtening the eye; of this fluid, the part which does not exhale is abſorbed by the puncta lachrymalia, and carried into the noſtrils; but as this is not a nutritive fluid, the analogy goes no farther than its ſecretion into the open air, and its re-abſorption into the ſyſtem; every other ſecreted fluid in the animal body is in part abſorbed again into the ſyſtem; even thoſe which are eſteemed excrementitious, as the urine and perſpirable matter, of which the latter is ſecreted, like the honey, into the external air. That the honey is a nutritious fluid, perhaps the moſt ſo of any vegetable production, appears from its great ſimilarity to ſugar, and from its affording ſuſtenance to ſuch numbers of inſects, which live upon it ſolely during ſummer, and lay it up for their winter proviſion. Theſe proofs of its nutritive nature evince the neceſſity of its re-abſorption into the vegetable ſyſtem, for ſome uſeful purpoſe.

This purpoſe, however, has, as yet, eſcaped the reſearches of philoſophical botaniſts. M. Pontedera believes it deſigned to lubricate the vegetable uterus, and compares the horn-like nectaries of ſome flowers to the appendicle of the cæcum inteſtinum of animals. (Antholog. p. 49.) Others have ſuppoſed, that the honey, when re-abſorbed, might ſerve the purpoſe of the liquor amnii, or white of the egg, as a nutriment for the young embryon, or fecundated ſeed, in its early ſtate of exiſtence. But as the nectary is found equally general in male flowers as in female ones; and as the young embryon, or ſeed, grows before the petals and nectary are expanded, and after they fall off; and, thirdly, as the nectary ſo ſoon falls off after the fecundation of the piſtillum; theſe ſeem to be inſurmountable objections to both the above-mentioned opinions.

In this ſtate of uncertainty, conjectures may be of uſe ſo far as they lead to further experiment and inveſtigation. In many tribes of inſects, as the ſilk-worm, and, perhaps, in all the moths and butterflies, the male and female parents die as ſoon as the eggs are impregnated and excluded; the eggs remaining to be perfected and hatched at ſome future time. The ſame thing happens in regard to the male and female parts of flowers; the anthers and filaments, which conſtitute the male parts of the flower, and the ſtigma and ſtyle, which conſtitute the female parts of the flower, fall off, and die, as ſoon as the ſeeds are impregnated, and along with theſe the petals and nectary. Now, the moths and butterflies above-mentioned, as ſoon as they acquire the paſſion and the apparatus for the reproduction of their ſpecies, loſe the power of feeding upon leaves as they did before, and become nouriſhed by what?—by honey alone.

Hence we acquire a ſtrong analogy for the uſe of the nectary, or ſecretion of honey in the vegetable economy, which is, that the male parts of flowers, and the female parts, as ſoon as they leave their fœtus-ſtate, expanding their petals (which conſtitute their lungs), become ſenſible to the paſſion, and gain the apparatus for the reproduction of their ſpecies, and are fed and nouriſhed with honey, like the inſects above deſcribed; and that hence the nectary begins its office of producing honey, and dies, or ceaſes to produce honey, at the ſame time with the birth and death of the ſtamens and the piſtils; which, whether exiſting in the ſame or in different flowers, are ſeparate and diſtinct animated beings.

Previous to this time, the anthers with their filaments, and the ſtigmas with their ſtyles, are, in their fœtus-ſtate, ſuſtained by their placental veſſels, like the unexpanded leaf-bud, with the ſeeds exiſting in the vegetable womb, yet unimpregnated, and the duſt, yet unripe, in the cells of the anthers. After this period they expand their petals, which have been ſhewn above to conſtitute the lungs of the flower; the placental veſſels, which before nouriſhed the anthers and the ſtigmas, coaleſce, or ceaſe to nouriſh them; and they now acquire blood more oxygenated by the air, obtain the paſſion and power of reproduction, are ſenſible to heat, and cold, and moiſture, and to mechanic ſtimulus, and become, in reality, inſects fed with honey, ſimilar in every reſpect, except their being attached to the tree on which they were produced.

Some experiments I have made this ſummer, by cutting out the nectaries of ſeveral flowers of the aconites, before the petals were open, or had become much coloured: ſome of theſe flowers, near the ſummit of the plants, produced no ſeeds; others, lower down, produced ſeeds; but they were not ſufficiently guarded from the farina of the flowers in their vicinity; nor have I had opportunity to try if theſe ſeeds would vegetate.

I am acquainted with a philoſopher, who, contemplating this ſubject, thinks it not impoſſible, that the firſt inſects were the anthers or ſtigmas of flowers; which had, by ſome means, looſed themſelves from their parent plant, like the male flowers of Valliſneria; and that many other inſects have gradually, in long proceſs of time, been formed from theſe; ſome acquiring wings, others fins, and others claws, from their ceaſeleſs efforts to procure their food, or to ſecure themſelves from injury. He contends, that none of theſe changes are more incomprehenſible than the transformation of tadpoles into frogs, and caterpillars into butterflies.

There are parts of animal bodies which do not require oxygenated blood for the purpoſe of their ſecretions, as the liver, which, for the production of bile, takes its blood from the meſenteric veins, after it muſt have loſt the whole or a great part of its oxygenation, which it had acquired in its paſſage through the lungs. In like manner the pericarpium, or womb of the flower, continues to ſecrete its proper juices for the preſent nouriſhment of the newly animated embryon-ſeed; and the ſaccharine, aceſcent, or ſtarchy matter of the fruit or ſeed-lobes, for its future growth, in the ſame manner as theſe things went on before fecundation; that is, without any circulation of juices in the petals, or production of honey in the nectary; theſe having periſhed, and fallen off, with the male and female apparatus for impregnation.

It is probable that the depredations of inſects on this nutritious fluid, muſt be injurious to the products of vegetation, and would be much more ſo, but that the plants have either acquired means to defend their honey in part, or have learned to make more than is abſolutely neceſſary for their own economy. In the ſame manner the honey-dew on trees is very injurious to them; in which diſeaſe the nutritive fluid, the vegetable ſap-juice, ſeems to be exſuded by a retrograde motion of the cutaneous lymphatics, as in the ſweating ſickneſs of the laſt century. To prevent the depredation of inſects on honey, a wealthy man in Italy is ſaid to have poiſoned his neighbour's bees, perhaps by mixing arſenic with honey, againſt which there is a moſt flowery declamation in Quintilian, No. XIII. As the uſe of the wax is to preſerve the duſt of the anthers from moiſture, which would prematurely burſt them, the bees which collect this for the conſtruction of the combs or cells, muſt, on this account, alſo injure the vegetation of a country where they too much abound.

It is not eaſy to conjecture why it was neceſſary that this ſecretion of honey ſhould be expoſed to the open air in the nectary, or honey-cup, for which purpoſe ſo great an apparatus for its defence from inſects and from ſhowers became neceſſary. This difficulty increaſes when we recollect that the ſugar in the joints of graſs, in the ſugar-cane, and in the roots of beets, and in ripe fruits, is produced without expoſure to the air.—On ſuppoſition of its ſerving for nutriment to the anthers and ſtigmas, it may thus acquire greater oxygenation, for the purpoſe of producing greater powers of ſenſibility, according to a doctrine lately advanced by a French philoſopher, who has endeavoured to ſhew, that the oxygene, or baſe of vital air, is the conſtituent principle of our power of ſenſibility.

So caterpillars are fed upon the common juices of vegetables found in their leaves, till they acquire the organs of reproduction, and then they feed on honey; all, I believe, except the ſilk-worm, which, in this country, takes no nouriſhment after it becomes a butterfly. Thus alſo the maggot of the bee, according to the obſervations of Mr. Hunter, is fed with raw vegetable matter, called bee-bread, which is collected from the anthers of flowers, and laid up in cells for that purpoſe, till the maggot becomes a winged bee, acquires greater ſenſibility, and is fed with honey. Phil. Tranſ. 1792. See Zoonomia, Sect. XIII. on vegetable animation.

From this proviſion of honey for the male and female parts of flowers, and from the proviſion of ſugar, ſtarch, oil, and mucilage, in the fruits, ſeed-cotyledons, roots, and buds of plants, laid up for the nutriment of the expanding fœtus, not only a very numerous claſs of inſects, but a great part of the larger animals procure their food, and thus enjoy life and pleaſure without producing pain to others; for theſe ſeeds or eggs, with the nutriment laid up in them, are not yet endued with ſenſitive life.

The ſecretions from various vegetable glands, hardened in the air, produce gums, reſins, and various kinds of ſaccharine, ſaponaceous, and wax-like ſubſtances, as the gum of cherry or plumb trees, gum tragacanth from the aſtragulus tragacantha, camphor from the laurus camphora, elemi from amyris elemifera, aneme from hymenœa courbaril, turpentine from piſtacia terebinthus, balſam of Mecca from the buds of amyris opobalſamum, branches of which are placed in the temples of the Eaſt, on account of their fragrance; the wood is called xylobalſamum, and the fruit carpobalſamum; aloe from a plant of the ſame name, myrrh from a plant not yet deſcribed; the remarkably elaſtic reſin is brought into Europe principally in the form of flaſks, which look like black leather, and are wonderfully elaſtic, and not penetrable by water; rectified ether diſſolves it; its inflexibility is increaſed by warmth, and deſtroyed by cold; the tree which yields this juice is the jatropha elaſtica; it grows in Guaiana and the neighbouring tracts of America; its juice is ſaid to reſemble wax, in becoming ſoft by heat, but that it acquires no elaſticity till that property is communicated to it by a ſecret art, after which it is poured into moulds, and well dried, and can no longer be rendered fluid by heat.—Mr. de la Borde, phyſician at Cayenne, has given this account. Manna is obtained at Naples from the fraxinus ornus, or manna-aſh; it partly iſſues ſpontaneouſly, which is preferred, and partly exſudes from wounds made purpoſely in the month of Auguſt; many other plants yield manna more ſparingly. Sugar is properly made from the ſaccharum officinale, or ſugar-cane, but is found in the roots of beet and many other plants; American wax is obtained from the myrica cerifera, candleberry myrtle; the berries are boiled in water, and a green wax ſeparates; with luke-warm water, the wax is yellow: the ſeeds of croton ſebiferum are lodged in tallow: there are many other vegetable exſudations uſed in the various arts of dyeing, varniſhing, tanning, lacquering, and which ſupply the ſhop of the druggiſt with medicines and with poiſons.

There is another analogy, which would ſeem to aſſociate plants with animals, and which, perhaps, belongs to this note on Glandulation; I mean the ſimilarity of their digeſtive powers. In the roots of growing vegetables, as in the proceſs of making malt, the farinaceous part of the ſeed is converted into ſugar by the vegetable power of digeſtion, in the ſame manner as the farinaceous matter of ſeeds is converted into ſweet chyle by the animal digeſtion. The ſap-juice which riſes in the vernal months from the roots of trees, through the alburnum, or ſap-wood, owes its ſweetneſs, I ſuppoſe, to a ſimilar digeſtive power of the abſorbent ſyſtem of the young buds. This exiſts in many vegetables in great abundance, as in vines, ſycamore, birch, and moſt abundantly in the palm-tree (Iſert's Voyage to Guinea), and ſeems to be a ſimilar fluid in all plants, as chyle is ſimilar in all animals.

Hence, as the digeſted food of vegetables conſiſts principally of ſugar, and from that is produced again their mucilage, ſtarch, and oil, and ſince animals are ſuſtained by theſe vegetable productions, it would ſeem, that the ſugar-making proceſs carried on in vegetable veſſels was the great ſource of life to all organized beings. And that, if our improved chemiſtry ſhould ever diſcover the art of making ſugar from foſſile or aerial matter, without the aſſiſtance of vegetation, food for animals would then become as plentiful as water, and mankind might live upon the earth as thick as blades of graſs, with no reſtraint to their numbers but the want of local room.

It would ſeem, that roots fixed in the earth, and leaves, innumerable, waving in the air, were neceſſary for the decompoſition of water, and the converſion of it into ſaccharine matter, which would have been not only cumberous, but totally incompatible with the locomotion of animal bodies. For how could a man or quadruped have carried on his head or back a foreſt of leaves, or have had long branching lacteal or abſorbent veſſels terminating in the earth? Animals, therefore, ſubſiſt on vegetables; that is, they take the matter ſo far prepared, and have organs to prepare it further for the purpoſes of higher animation, and greater ſenſibility. In the ſame manner the apparatus of green leaves and long roots were found inconvenient for the more animated and ſenſitive parts of vegetable flowers; I mean the anthers and ſtigmas, which are, therefore, ſeparate beings, endued with the paſſion and power of reproduction, with lungs of their own, and fed with honey, a food ready prepared by the long roots and green leaves of the plant, and preſented to their abſorbent mouths.

From this outline, a philoſopher may catch a glimpſe of the general economy of nature; and, like the mariner caſt upon an unknown ſhore, who rejoiced when he ſaw the print of a human foot upon the ſand, he may cry out with rapture, "A GOD DWELLS HERE."

# VISIT OF HOPE

### TO

# *SYDNEY COVE,*

### NEAR

# BOTANY-BAY.

*Referred to in Canto* II. l. 317.

WHERE Sydney Cove her lucid boſom ſwells,
And with wide arms the indignant ſtorm repels;
High on a rock, amid the troubled air,
Hope ſtood ſublime, and wav'd her golden hair;
Calm'd with her roſy ſmile the toſſing deep,
And with ſweet accents charm'd the winds to ſleep;
To each wild plain ſhe ſtretch'd her ſnowy hand,
High-waving wood, and ſea-encircled ſtrand.
" Hear me," ſhe cried, " ye riſing realms! record
" Time's opening ſcenes, and Truth's prophetic word.—
" *There* ſhall broad ſtreets their ſtately walls extend,
" The circus widen, and the creſcent bend;
" *There*, ray'd from cities o'er the cultur'd land,
" Shall bright canals, and ſolid roads expand.—
" *There* the proud arch, coloſſus-like, beſtride
" Yon glittering ſtreams, and bound the chafing tide;
" Embelliſh'd villas crown the landſcape-ſcene,
" Farms wave with gold, and orchards bluſh between.—
" *There* ſhall tall ſpires, and dome-capt towers aſcend,
" And piers and quays their maſſy ſtructures blend;
" While with each breeze approaching veſſels glide,
" And northern treaſures dance on every tide!"
Then ceas'd the nymph—tumultuous echoes roar,
And Joy's loud voice was heard from ſhore to ſhore—
Her graceful ſteps, deſcending, preſs'd the plain,
And Peace, and Art, and Labour, join'd her train.

Mr. Wedgwood, having been favoured by Sir Joſeph Banks with a ſpecimen of clay from Sydney Cove, has made a few medallions of it, repreſenting Hope encouraging Art and Labour, under the influence of Peace, to purſue the employments neceſſary for rendering an infant colony ſecure and happy. The above verſes were written by the author of the Botanic Garden, to accompany theſe medallions.

# THE
# BOTANIC GARDEN.

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## OF THE
## *ADDITIONAL NOTES.*

### NOTE I.—METEORS.

THERE are four ſtrata of the atmoſphere, and four kinds of meteors. 1. Lightning is electric, exiſts in viſible clouds, its ſhort courſe, and red light. 2. Shooting ſtars exiſt in viſible vapour, without ſound, white light, have no luminous trains. 3. Twilight; fire-balls move thirty miles in a ſecond, and are about ſixty miles high; have luminous trains, occaſioned by an electric ſpark paſſing between the aerial and inflammable ſtrata of the atmoſphere, and mixing them and ſetting them on fire in its paſſage; attracted by volcanic eruptions; one thouſand miles through ſuch a medium reſiſts leſs than the tenth of an inch of glaſs. 4. Northern lights not attracted to a point, but diffuſed; their colours; paſſage of electric fire in vacuo dubious; Dr. Franklin's theory of northern lights countenaced in part by the ſuppoſition of a ſuperior atmoſphere of inflammable air; antiquity of their appearance; deſcribed in Maccabees.

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### NOTE VIII.—MEMNON'S LYRE.

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CALCIFORM ores; combuſtion of iron in vital air; ſteel from deprivation of vital air; welding; hardneſs; brittleneſs like Rupert's drops; ſpecific levity; hardneſs and brittleneſs compared; ſteel tempered by its colours; modern production of iron, manganeſe, calamy; ſeptaria of iron-ſtone ejected from volcanos; red-hot cannon-balls.

### NOTE XIX.—FLINT.

1. *Siliceous rocks* from moraſſes; their cements. 2. *Siliceous trees;* coloured by iron or manganeſe; Peak-diamonds; Briſtol-ſtones; flint in form of calcareous ſpar; has been fluid without much heat; obtained from powdered quartz and fluor-acid by Bergman and by Achard. 3. *Agates and onyxes* found in ſand-rocks; of vegetable origin; have been in complete fuſion; their concentric coloured circles not from ſuperinduction, but from congelation; experiment of freezing a ſolution of the blue-vitriol; iron and manganeſe repelled in ſpheres, as the nodule of flint cooled; circular ſtains of marl in ſalt-mines; ſome flint nodules reſemble knots of wood or roots. 4. *Sand of the ſea;* its acid from moraſſes; its baſe from ſhells. *Chert or petroſilex* ſtratified in cooling; their colour and their acid from ſea-animals; Labradore-ſtone from mother-pearl. 6. *Flints in chalk-beds;* their form, colour, and acid, from the fleſh of ſea-animals; ſome are hollow, and lined with cryſtals; contain iron; not produced by injection from without; coralloids converted to flint; French mill-ſtones; flints ſometimes found in ſolid ſtrata. 7. *Angles of ſand* deſtroyed by attrition and ſolution in ſteam; ſiliceous breccia cemented by ſolution in red-hot water. 8. *Baſaltes and granites* are ancient lavas; baſaltes raiſed by its congelation, not by ſubterraneous fire.

### NOTE XX.—CLAY.

FIRE and water two great agents; ſtratification from precipitation; many ſtratified materials not ſoluble in water. 1. Stratification of lava from ſucceſſive accumulation. 2. Stratifications of lime-ſtone from the different periods of time in which the ſhells were depoſited. 3. Stratifications of coal, and clay, and ſand-ſtone, and iron-ores, not from currents of water, but from the production of moraſs-beds, at different periods of time; moraſs-beds become ignited; their bitumen and ſulphur is ſublimed, the clay, lime, and iron, remain; whence ſand, marl, coal, white clay in valleys, and gravel-beds, and ſome ochres, and ſome calcareous depoſitions, owing to alluviation; clay from decompoſed granite; from the lava of Veſuvius; from vitreous lavas.

### Note XXI.—Enamels.

Rose-colour and purple from gold; precipitates of gold by alkaline ſalt preferable to thoſe by tin; aurum fulminans long ground; tender colours from gold or iron not diſſolved, but ſuſpended in the glaſs; cobalts; calces of cobalt and copper require a ſtrong fire; Ka-o-lin and Pe-tun-tſe the ſame as our own materials.

### Note XXII.—Portland Vase.

Its figures do not allude to private hiſtory; they repreſent a part of the Eleuſinian myſteries; marriage of Cupid and Pſyche; proceſſion of torches; the figures in one compartment repreſent Mortal Life in the act of expiring, and Humankind attending to her with concern; Adam and Eve hieroglyphic figures; Abel and Cain other hieroglyphic figures: on the other compartment is repreſented Immortal Life; the Manes, or Ghoſt, deſcending into Elyſium, is led on by Divine Love, and received by Immortal Life, and conducted to Pluto; Trees of Life and Knowledge are emblematical: the figure at the bottom is of Atis, the firſt great Hierophant, or teacher of myſteries.

### Note XXIII.—Coal.

1. A fountain of foſſile tar in Shropſhire; has been diſtilled from the coal-beds beneath, and condenſed in the cavities of a ſand-rock; the coal beneath is deprived of its bitumen in part; bitumen ſublimed at Matlock, into cavities lined with ſpar. 2. Coal has been expoſed to heat; woody fibres and vegetable ſeeds in coal at Bovey and Poleſworth; upper part of coal-beds more bituminous at Beaudeſert; thin ſtratum of aſphaltum near Caulk; upper part of coal-bed worſe at Alfreton; upper ſtratum of no value at Widdrington; alum at Weſt-Hallum; at Bilſton. 3. Coal at Coalbrook-Dale has been immerſed in the ſea, ſhewn by ſea-ſhells; marks of violence in the colliery at Mendip and at Ticknal; lead-ore and ſpar in coal-beds; gravel over coal near Lichfield; coal produced from moraſſes, ſhewn by fern-leaves, and bog-ſhells, and muſcle-ſhells; by ſome parts of coal being ſtill woody; from Loch Neagh, and Bovey, and the Temple of the Devil; fixed alkali; oil.

### Note XXIV.—Granite.

Granite the loweſt ſtratum of the earth yet known; porphyry, trap, moor-ſtone, whin-ſtone, ſlate, baſaltes, all volcanic productions diſſolved in red-hot water; volcanos in granite ſtrata; differ from the heat of moraſſes from fermentation; the nucleus of the earth ejected from the ſun; was the ſun originally a planet? ſuppoſed ſection of the globe.

## NOTE XXV.—EVAPORATION.

I. 1. SOLUTION of water in air; in the matter of heat; pulſe-glaſs. 2. Heat is the principal cauſe of evaporation; thermometer cooled by evaporation of ether; heat given from ſteam to the worm-tub; warmth accompanying rain. 3. Steam condenſed on the eduction of heat; moiſture on cold walls; ſouth-weſt and north-eaſt winds. 4. Solution of ſalt and of blue vitriol in the matter of heat. II. Other vapours may precipitate ſteam, and form rain. 1. Cold the principal cauſe of devaporation; hence the ſteam diſſolved in heat is precipitated, but that diſſolved in air remains even in froſts; ſouth-weſt wind. 2. North-eaſt winds mixing with ſouth-weſt winds produce rain; becauſe the cold particles of air of the north-eaſt acquire ſome of the matter of heat from the ſouth-weſt winds. 3. Devaporation from mechanical expanſion of air, as in the receiver of an air-pump; ſummer clouds appear and vaniſh; when the barometer ſinks without change of wind, the weather becomes colder. 4. Solution of water in electric fluid dubious. 5. Barometer ſinks from the leſſened gravity of the air, and from the rain having leſs preſſure as it falls; a mixture of a ſolution of water in calorique, with an aerial ſolution of water, is lighter than dry air; breath of animals in cold weather, why condenſed into viſible vapour, and diſſolved again.

## NOTE XXVI.—SPRINGS.

LOWEST ſtrata of the earth appear on the higheſt hills; ſprings from dews ſliding between them; mountains are colder than plains; 1. From their being inſulated in the air; 2. From their enlarged ſurface; 3. From the rarity of the air it becomes a better conductor of heat; 4. By the air on mountains being mechanically rarefied as it aſcends; 5. Gravitation of the matter of heat; 6. The daſhing of clouds againſt hills; of fogs againſt trees; ſprings ſtronger in hot days with cold nights; ſtreams from ſubterranean caverns; from beneath the ſnow on the Alps.

## NOTE XXVII.—SHELL-FISH.

THE armour of the Echinus moveable; holds itſelf in ſtorms to ſtones, by 1200 or 2000 ſtrings: Nautilus rows and ſails; renders its ſhell buoyant: Pinna and cancer; Byſſus of the ancients was the beard of the Pinna; as fine as the ſilk is ſpun by the ſilk-worm; gloves made of it; the beard of muſcles produces ſickneſs; Indian-weed; tendons of rats' tails.

## NOTE XXVIII.—STURGEON.

STURGEON's mouth like a purſe; without teeth; tendrils like worms hang before his lips, which entice ſmall fiſh and ſea-inſects, miſtaking them for worms; his ſkin uſed for covering carriages; iſinglaſs made from it; caviare from the ſpawn.

### NOTE XXIX.—OIL ON WATER.

OIL and water do not touch; a ſecond drop of oil will not diffuſe itſelf on the preceding one; hence it ſtills the waves; divers for pearl carry oil in their mouths; oil on water produces priſmatic colours; oiled cork circulates on water; a phial of oil and water made to oſcillate.

### NOTE XXX.—SHIP-WORM.

THE Teredo has calcareous jaws; a new enemy; they periſh when they meet together in their ligneous canals; United Provinces alarmed for the piles of the banks of Zealand; were deſtroyed by a ſevere winter.

### NOTE XXXI.—MAELSTROM.

A WHIRLPOOL on the coaſt of Norway, paſſes through a ſubterraneous cavity; leſs violent when the tide is up; eddies become hollow in the middle; heavy bodies are thrown out by eddies; light ones retained; oil and water whirled in a phial; hurricanes explained.

### NOTE XXXII.—GLACIERS.

SNOW in contact with the earth is in a ſtate of thaw; ice-houſes; rivers from beneath the ſnow; rime, in ſpring, vaniſhes by its contact with the earth; and ſnow by its evaporation and contact with the earth; moſs vegetates beneath the ſnow; and Alpine plants periſh at Upſal for want of ſnow.

### NOTE XXXIII.—WINDS.

AIR is perpetually ſubject to increaſe and to diminution; Oxygene is perpetually produced from vegetables in the ſunſhine, and from clouds in the light, and from water; Azote is perpetually produced from animal and vegetable putrefaction, or combuſtion; from ſprings of water; volatile alkali; fixed alkali; ſea-water; they are both perpetually diminiſhed by their contact with the ſoil, producing nitre; Oxygene is diminiſhed in the production of all acids; Azote by the growth of animal bodies; charcoal in burning conſumes double its weight of pure air; every barrel of red-lead abſorbs 2000 cubic feet of vital air; air obtained from variety of ſubſtances by Dr. Prieſtley; Officina aeris in the polar circle, and at the line. *South-weſt winds;* their weſterly direction from the leſs velocity of the earth's ſurface; the contrary in reſpect to north-eaſt winds; South-weſt winds conſiſt of regions of air from the ſouth; and north-eaſt winds of regions of air from the north; when the ſouth-weſt prevails for weeks, and the barometer ſinks to 28, what becomes of above one fifteenth part of the atmoſphere? 1. It is not carried back by ſuperior currents; 2. Not from its loſs of moiſture;

3. Not carried over the pole; 4. Not owing to atmoſpheric tides or mountains; 5. It is abſorbed at the polar circle; hence ſouth-weſt winds and rain; ſouth-weſt ſometimes cold. *North-eaſt winds* conſiſt of air from the north; cold by the evaporation of ice; are dry winds; 1. Not ſupplied by ſuperior currents; 2. The whole atmoſphere increaſed in quantity by air ſet at liberty from its combinations in the polar circles. *South-eaſt winds* conſiſt of north winds driven back. *North-weſt winds* conſiſt of ſouth-weſt winds driven back; north-weſt winds of America bring froſt; owing to a vertical ſpiral eddy of air between the eaſtern coaſt and the Apalachian mountains; hence the greater cold of North-America. *Trade-winds;* air over the line always hotter than at the tropics; trade-winds gain their eaſterly direction from the greater velocity of the earth's ſurface at the line; not ſupplied by ſuperior currents; ſupplied by decompoſed water in the ſun's great light; 1. Becauſe there are no conſtant rains in the tract of the trade-winds; 2. Becauſe there is no condenſible vapour above three or four miles high at the line. *Monſoons and Tornadoes;* ſome places at the tropic become warmer when the ſun is vertical than at the line; hence the air aſcends, ſupplied on one ſide by the north-eaſt winds, and on the other by the ſouth-weſt; whence an aſcending eddy or tornado, raiſing water from the ſea, or ſand from the deſert, and inceſſant rains; air diminiſhed to the northward produces ſouth-weſt winds; tornadoes from heavier air above ſinking through lighter air below, which riſes through a perforation; hence trees are thrown down in a narrow line of twenty or forty yards broad, the ſea riſes like a cone, with great rain and lightning. *Land and ſea breezes;* ſea leſs heated than land; tropical iſlands more heated in the day than the ſea, and are cooled more in the night. *Concluſion;* irregular winds from other cauſes; only two original winds, north and ſouth; different ſounds of north-eaſt and ſouth-weſt winds; a Bear or Dragon in the arctic circle that ſwallows at times, and diſembogues again, above one fifteenth part of the atmoſphere; wind-inſtruments; recapitulation.

### NOTE XXXIV.—VEGETABLE PERSPIRATION.

PURE air from Dr. Prieſtley's vegetable matter, and from vegetable leaves, owing to decompoſition of water; the hydrogene retained by the vegetables; plants in the ſhade are *tanned* green by the ſun's light; animal ſkins are *tanned* yellow by the retention of hydrogene; much pure air from dew on a ſunny morning; bleaching, why ſooner performed on cotton than linen; bees wax bleached; metals calcined by decompoſition of water; oil bleached in the light becomes yellow again in the dark; nitrous acid coloured by being expoſed to the ſun; vegetables perſpire more than animals, hence in the ſunſhine they purify air more by their perſpiration than they injure it by their reſpiration; they grow faſteſt in their ſleep.

### NOTE XXXV.—VEGETABLE PLACENTATION.

Buds the viviparous offſpring of vegetables; placentation in bulbs and ſeeds; placentation of buds in the roots, hence the riſing of ſap in the ſpring, as in vines, birch, which ceaſes as ſoon as the leaves expand; production of the leaf of Horſe-cheſnut, and of its new bud; oil of vitriol on the bud of Mimoſa killed the leaf alſo; placentation ſhewn from the ſweetneſs of the ſap; no umbilical artery in vegetables.

### NOTE XXXVI.—VEGETABLE CIRCULATION.

Buds ſet in the ground will grow if prevented from bleeding to death by a cement; vegetables require no muſcles of locomotion, no ſtomach or bowels, no general ſyſtem of veins; they have, 1. Three ſyſtems of abſorbent veſſels; 2. Two pulmonary ſyſtems; 3. Arterial ſyſtems; 4. Glands; 5. Organs of reproduction; 6. muſcles. I. Abſorbent ſyſtem evinced by experiments by coloured abſorptions in fig-tree and picris; called air-veſſels erroneouſly; ſpiral ſtructure of abſorbent veſſels; retrograde motion of them like the throats of cows. II. Pulmonary arteries in the leaves; and pulmonary veins; no general ſyſtem of veins ſhewn by experiment; no heart; the arteries act like the vena portarum of the liver; pulmonary ſyſtem in the petals of flowers; circulation owing to living irritability; vegetable abſorption more powerful than animal, as in vines; not by capillary attraction.

### NOTE XXXVII.—VEGETABLE RESPIRATION.

I. Leaves not perſpiratory organs, nor excretory ones; lungs of animals. 1. Great ſurfaces of leaves. 2. Vegetable blood changes colour in the leaves; experiment with ſpurge; with picris. 3. Upper ſurface of the leaf only acts as a reſpiratory organ. 4. Upper ſurface repels moiſture; leaves laid on water. 5. Leaves killed by oil like inſects; muſcles at the foot-ſtalks of leaves. 6. Uſe of light to vegetable leaves; experiments of Prieſtley, Ingenhouz, and Scheele. 7. Vegetable circulation ſimilar to that of fiſh. II. Another pulmonary ſyſtem belongs to flowers; colours of flowers. 1. Vaſcular ſtructure of the corol. 2. Glands producing honey, wax, &c. periſh with the corol. 3. Many flowers have no green leaves attending them, as Colchicum. 4. Corols not for the defence of the ſtamens. 5. Corol of Helleborus Niger changes to a calyx. 6. Green leaves not neceſſary to the fruit-bud; green leaves of Colchicum belong to the new bulb, not to the flower. 7. Flower-bud after the corol falls is ſimply an uterus; mature flowers not injured by taking off the green leaves. 8. Inoſculation of vegetable veſſels.

### NOTE XXXVIII.—VEGETABLE IMPREGNATION.

Seeds in broom diſcovered twenty days before the flower opens; progreſs of the ſeeds after impregnation; ſeeds exiſt before fecundation; analogy between ſeeds and eggs; progreſs of the egg within the hen; ſpawn of frogs and fiſhes; male Salamander; marine plants project a liquor, not a powder; ſeminal fluid diluted with water, if a ſtimulus only? Male and female influence neceſſary in animals, inſects, and vegetables, both in production of ſeeds and buds; does the embryon ſeed produce the ſurrounding fruit, like inſects in gall-nuts?

### NOTE XXXIX.—VEGETABLE GLANDULATION.

VEGETABLE glands cannot be injected with coloured fluids; eſſential oil; wax; honey; nectary, its complicate apparatus; expoſes the honey to the air like the lachrymal gland; honey is nutritious; the male and female parts of flowers copulate and die like moths and butterflies, and are fed like them with honey; anthers ſuppoſed to become inſects; depredation of the honey and wax injurious to plants; honey-dew; honey oxygenated by expoſure to air; neceſſary for the production of ſenſibility; the proviſion for the embryon plant of honey, ſugar, ſtarch, &c. ſupplies food to numerous claſſes of animals; various vegetable ſecretions, as gum tragacanth, camphor, elemi, anime, turpentine, balſam of Mecca, aloe, myrrh, elaſtic reſin, manna, ſugar, wax, tallow, and many other concrete juices; vegetable digeſtion; chemical production of ſugar would multiply mankind; economy of nature.

END OF PART I.

THE

# BOTANIC GARDEN.

## PART II.

CONTAINING

# THE LOVES OF THE PLANTS.

*A POEM.*

WITH

## PHILOSOPHICAL NOTES.

> Vivunt in Venerem frondes; nemus omne per altum
> Felix arbor amat; nutant ad mutua Palmæ
> Fœdera, Populeo ſuſpirat Populus ictu,
> Et Platani Platanis, Alnoque aſſibilat Alnus. CLAUD. EPITH.

[illegible]

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# PREFACE.

LINNÆUS has divided the vegetable world into 24 Claſſes; theſe Claſſes into about 120 Orders; theſe Orders contain about 2000 Families, or Genera; and theſe Families about 20,000 Species; beſides the innumerable Varieties, which the accidents of climate or cultivation have added to theſe Species.

The Claſſes are diſtinguiſhed from each other in this ingenious ſyſtem, by the number, ſituation, adheſion, or reciprocal proportion of the males in each flower. The Orders, in many of theſe Claſſes, are diſtinguiſhed by the number, or other circumſtances of the females. The Families, or Genera, are characterized by the analogy of all the parts of the flower or fructification. The Species are diſtinguiſhed by the foliage of the plant; and the Varieties by any accidental circumſtance of colour, taſte, or odour; the ſeeds of theſe do not always produce plants ſimilar to the parent; as in our numerous fruit-trees and garden flowers; which are propagated by grafts or layers.

The firſt eleven Claſſes include the plants, in whoſe flowers both the ſexes reſide; and in which the Males or Stamens are neither united, nor unequal in height when at maturity; and are, therefore, diſtinguiſhed from each other ſimply by the number of males in each flower, as is ſeen in the annexed PLATE, copied from the Dictionaire Botanique of M. BULLIARD, in which the numbers of each diviſion refer to the Botanic Claſſes.

CLASS I. ONE MALE, *Monandria*; includes the plants which poſſeſs but One Stamen in each flower.

II. TWO MALES, *Diandria*. Two Stamens.

III. THREE MALES, *Triandria.* Three Stamens.
IV. FOUR MALES, *Tetrandria.* Four Stamens.
V. FIVE MALES, *Pctandria.* Five Stamens.
VI. SIX MALES, *Hexandria.* Six Stamens.
VII. SEVEN MALES, *Heptandria.* Seven Stamens.
VIII. EIGHT MALES, *Octandria.* Eight Stamens.
IX. NINE MALES, *Enneandria.* Nine Stamens.
X. TEN MALES, *Decandria.* Ten Stamens.
XI. TWELVE MALES, *Dodecandria.* Twelve Stamens.

The next two Claſſes are diſtinguiſhed not only by the number of equal and diſunited males, as in the above eleven Claſſes, but require an additional circumſtance to be attended to, *viz.* whether the males or ſtamens be ſituated on the calyx, or not

XII. TWENTY MALES, *Icoſandria.* Twenty Stamens inſerted on the calyx, or flower-cup; as is well ſeen in the laſt Figure of No. xii. in the annexed Plate.

XIII. MANY MALES, *Polyandria.* From 20 to 100 Stamens, which do not adhere to the calyx; as is well ſeen in the firſt figure of No. xiii. in the annexed Plate.

In the next two Claſſes, not only the number of ſtamens are to be obſerved, but the reciprocal proportions in reſpect to height.

XIV. TWO POWERS, *Didynamia.* Four Stamens, of which two are lower than the other two; as is ſeen in the two firſt Figures of No. xiv.

XV. FOUR POWERS, *Tetradynamia.* Six Stamens, of which four are taller, and the two lower ones oppoſite to each other; as is ſeen in the third Figure of the upper row, in No. xv.

The five ſubſequent Claſſes are diſtinguiſhed not by the number of the males, or ſtamens, but by their union or adheſion, either by their anthers or filaments, or to the female, or piſtil.

XVI. ONE BROTHERHOOD, *Monadelphia.* Many Stamens united by their filaments into one company; as in the ſecond Figure below of No. xvi.

XVII. TWO BROTHERHOODS, *Diadelphia.* Many Stamens united by their filaments into two companies; as in the uppermoſt Figure, No. xvii.

XVIII. MANY BROTHERHOODS, *Polyadelphia.* Many Stamens united by their filaments into three or more companies; as in No. xviii.

XIX. CONFEDERATE MALES, *Syngeneſia.* Many Stamens united by their anthers; as in the firſt and ſecond Figures, No. xix.

XX. FEMININE MALES, *Gynandria.* Many Stamens attached to the piſtil.

The next three Claſſes conſiſt of plants, whoſe flowers contain but one of the ſexes; or if ſome of them contain both ſexes, there are other flowers accompanying them of but one ſex.

XXI. ONE HOUSE, *Monœcia.* Male flowers and female flowers ſeparate, but on the ſame plant.

XXII. TWO HOUSES, *Diœcia.* Male flowers and female flowers ſeparate, on different plants.

XXIII. POLYGAMY, *Polygamia.* Male and female flowers on one or more plants, which have, at the ſame time, flowers of both ſexes.

The laſt Claſs contains the plants whoſe flowers are not diſcernible.

XXIV. CLANDESTINE MARRIAGE, *Cryptogamia.*

The Orders of the firſt thirteen Claſſes are founded on the number of Females, or Piſtils, and diſtinguiſhed by the names, ONE FEMALE, *Monogynia.* TWO FEMALES, *Digynia.* THREE FEMALES, *Trigynia, &c.* as is ſeen in No. i. which repreſents a plant of one male, one female; and in the firſt Figure of No. xi. which repreſents a flower with twelve males, and three females; (for, where the piſtils have no apparent ſtyles, the ſummits, or ſtigmas, are to be numbered,) and in the firſt Figure of No. xii. which repreſents a flower with twenty males, and many females; and in the laſt Figure of the ſame No. which has twenty males, and one female;

and in No. xiii. which repreſents a flower with many males, and many females.

The Claſs of Two Powers, is divided into two natural Orders; into ſuch as have their ſeeds naked at the bottom of the calyx, or flower-cup; and ſuch as have their ſeeds covered; as is ſeen in No. xiv. Fig. 3 and 5.

The Claſs of Four Powers, is divided alſo into two Orders; in one of theſe the ſeeds are incloſed in a ſilicule, as in *Shepherd's purſe*, No. xv. Fig. 5. In the other they are incloſed in a ſilique; as in *Wall-flower*, Fig. 4.

In all the other Claſſes, excepting the Claſſes Confederate Males and Clandeſtine Marriage, as the character of each Claſs is diſtinguiſhed by the ſituations of the males; the character of the Orders is marked by the numbers of them. In the Claſs One Brotherhood, No. xvi. Fig. 3. the Order of ten males is repreſented. And in the Claſs Two Brotherhoods, No. xvii. Fig. 2. the Order of ten males is repreſented.

In the Claſs Confederate Males, the Orders are chiefly diſtinguiſhed by the fertility or barrenneſs of the florets of the diſk, or ray of the compound flower.

And in the Claſs of Clandestine Marriage, the four Orders are termed Ferns, Mosses, Flags, and Funguſses.

The Orders are again divided into Genera, or Families, which are all natural aſſociations, and are deſcribed from the general reſemblances of the parts of fructification, in reſpect to their number, form, ſituation, and reciprocal proportion. Theſe are the Calyx, or Flower-cup; as ſeen in No. iv. Fig. 1. No. x. Fig. 1, and 3. No. xiv. Fig. 1, 2, 3, 4. Second, the Corol, or Bloſſom; as ſeen in No. i. ii. &c. Third, the Males, or Stamens; as in No. iv. Fig. 1. and No. viii. Fig. 1. Fourth, the Females or Piſtils; as in No. i.

No. xii. Fig. 1. No. xiv. Fig. 3. No. xv. Fig. 3. Fifth, the Pericarp, or Fruit-veſſel; as in No. xv. Fig. 4, 5. No. xvii. Fig. 2. Sixth, the Seeds.

The illuſtrious author of the Sexual Syſtem of Botany, in his preface to his account of the Natural Orders, ingeniouſly imagines, that one plant of each Natural Order was created in the beginning; and that the intermarriages of theſe produced one plant of every Genus, or Family; and that the intermarriages of theſe Generic, or Family plants, produced all the ſpecies: and, laſtly, that the intermarriages of the individuals of the ſpecies produced the Varieties.

In the following POEM, the name or number of the Claſs or Order of each plant is printed in Italics, as "*Two* brother ſwains." "*One* houſe contains them;" and the word "*ſecret*," expreſſes the claſs of Clandeſtine Marriage.

The Reader who wiſhes to become further acquainted with this delightful field of ſcience, is adviſed to ſtudy the works of the Great Maſter, and is apprized that they are exactly and literally tranſlated into Engliſh, by a Society at LICHFIELD, in four Volumes Octavo.

To the SYSTEM OF VEGETABLES is prefixed a copious explanation of all the Terms uſed in Botany, tranſlated from a theſis of Dr. ELMSGREEN, with the plates and references from the Philoſophia Botannica of LINNÆUS.

To the FAMILIES OF PLANTS is prefixed a Catalogue of the names of plants, and other Botanic Terms, carefully accented, to ſhew their proper pronunciation; a work of great labour, and which was much wanted, not only by beginners, but by proficients in BOTANY.

# PROEM.

*GENTLE READER!*

LO, here a CAMERA OBSCURA is preſented to thy view, in which are lights and ſhades dancing on a whited canvas, and magnified into apparent life!—If thou art perfectly at leiſure for ſuch trivial amuſement, walk in, and view the wonders of my INCHANTED GARDEN.

Whereas P. OVIDIUS NASO, a great Necromancer in the famous Court of AUGUSTUS CÆSAR, did, by art poetic, tranſmute Men, Women, and even Gods and Goddeſſes, into Trees and Flowers; I have undertaken, by ſimilar art, to reſtore ſome of them to their original animality, after having remained priſoners ſo long in their reſpective vegetable manſions; and have here exhibited them before thee. Which thou may'ſt contemplate as diverſe little pictures, ſuſpended over the chimney of a

Lady's dreſſing room, *connected only by a ſlight feſtoon of ribbons.* And which, though thou may'ſt not be acquainted with the originals, may amuſe thee by the beauty of their perſons, their graceful attitudes, or the brilliancy of their dreſs.

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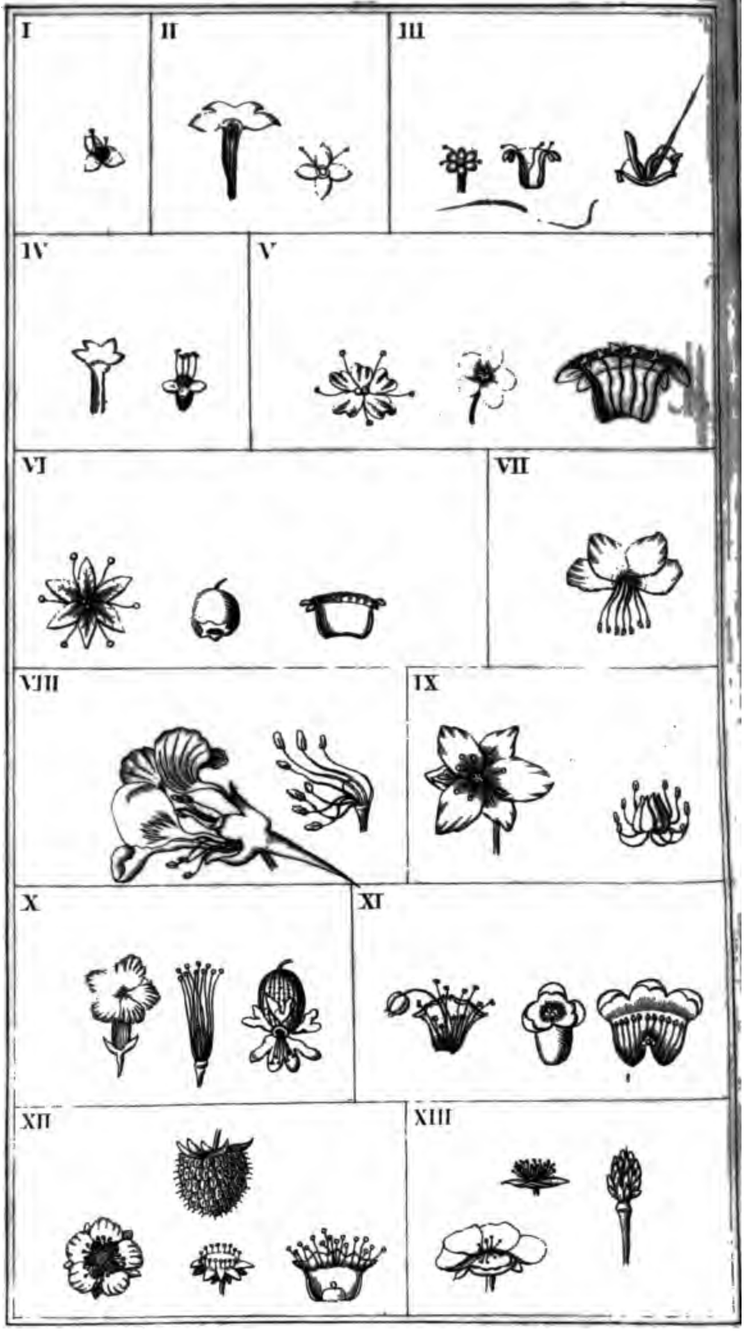
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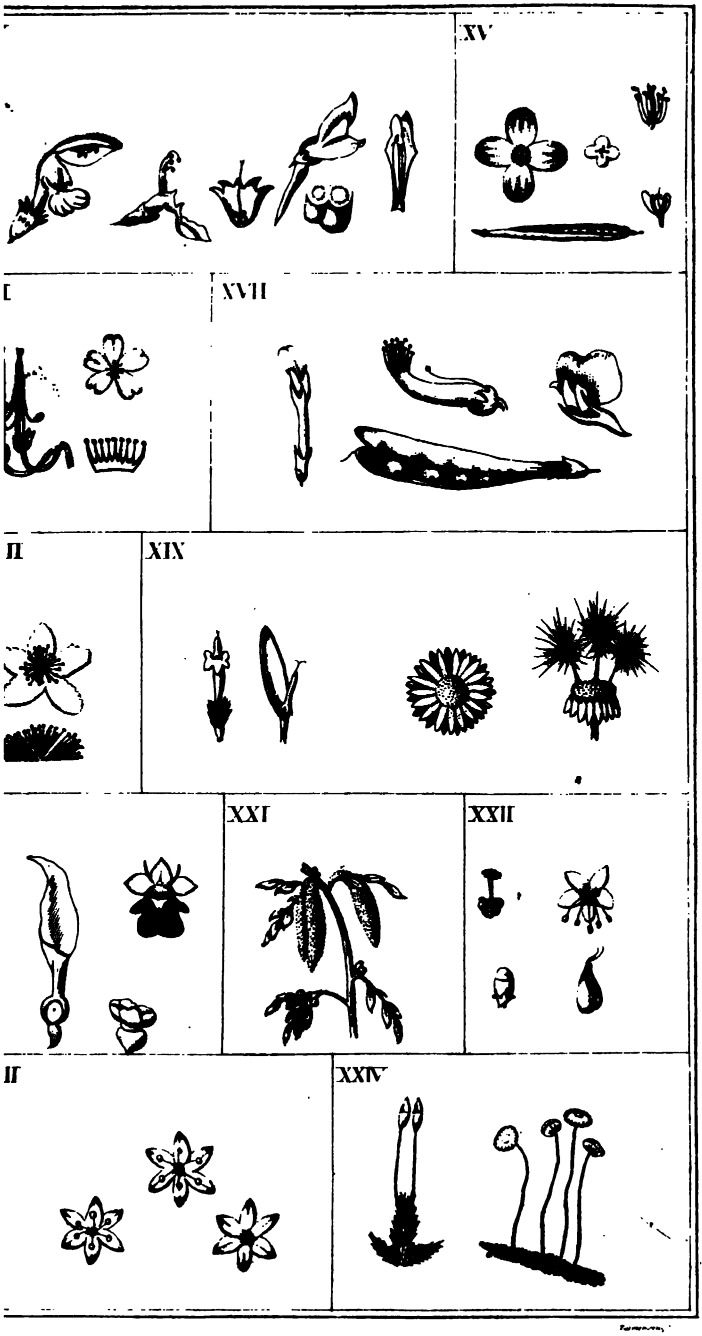
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ASTOR, LENOX AND
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# THE
# BOTANIC GARDEN.

## LOVES OF THE PLANTS.

### CANTO I.

DESCEND, ye hovering Sylphs! aerial Quires,
And ſweep with little hands your ſilver lyres;
With fairy footſteps print your graſſy rings,
Ye Gnomes! accordant to the tinkling ſtrings:
While in ſoft notes I tune to oaten reed
Gay hopes, and amorous ſorrows of the mead.—
From giant Oaks, that wave their branches dark,
To the dwarf Moſs that clings upon their bark,
What Beaux and Beauties crowd the gaudy groves,
And woo and win their vegetable Loves.
How Snow-drops cold, and blue-eyed Harebels blend
Their tender tears, as o'er the ſtream they bend;
The love-ſick Violet, and the Primroſe pale,
Bow their ſweet heads, and whiſper to the gale;
With ſecret ſighs the Virgin Lily droops,
And jealous Cowſlips hang their tawny cups.
How the young Roſe, in beauty's damaſk pride,
Drinks the warm bluſhes of his baſhful bride;
With honey'd lips enamoured Woodbines meet,
Claſp with fond arms, and mix their kiſſes ſweet.—

---

*Vegetable Loves.* l. 10. Linnæus, the celebrated Swediſh naturaliſt, has demonſtrated, that all flowers contain families of males or females, or both; and on their marriages has conſtructed his invaluable ſyſtem of Botany.

Stay thy ſoft-murmuring waters, gentle Rill;
Huſh, whiſpering Winds; ye ruſtling Leaves be ſtill;
Reſt, ſilver Butterflies, your quivering wings;
Alight, ye Beetles, from your airy rings;
Ye painted Moths, your gold-eyed plumage furl,
Bow your wide horns, your ſpiral trunks uncurl;
Glitter, ye Glow-worms, on your moſſy beds;
Deſcend, ye Spiders, on your lengthened threads;
Slide here, ye horned Snails, with varniſh'd ſhells;
Ye Bee-nymphs, liſten in your waxen cells!

BOTANIC MUSE! who, in this latter age,
Led by your airy hand the Swediſh ſage,
Bade his keen eye your ſecret haunts explore
On dewy dell, high wood, and winding ſhore;
Say on each leaf how tiny graces dwell;
How laugh the Pleaſures in a bloſſom's bell;
How inſect Loves ariſe on cobweb wings,
Aim their light ſhafts, and point their little ſtings.

"First the tall Canna lifts his curled brow
Erect to heaven, and plights his nuptial vow;
The virtuous pair, in milder regions born,
Dread the rude blaſt of Autumn's icy morn;
Round the chill fair he folds his crimſon veſt,
And claſps the timorous beauty to his breaſt.

Thy love Callitriche, *two* Virgins ſhare,
Smit with thy ſtarry eye and radiant hair;—
On the green margin ſits the youth, and laves
His floating train of treſſes in the waves;

---

*Canna.* l. 39. Cane, or Indian Reed. One male and one female inhabit each flower. It is brought from between the tropics to our hot-houſes, and bears a beautiful crimſon flower; the ſeeds are uſed as ſhot by the Indians, and are ſtrung for prayer-beads in ſome catholic countries.

*Callitriche.* l. 45. Fine-Hair, Stargraſs. One male and two females inhabit each flower. The upper leaves grow in form of a ſtar, whence it is called Stellaria Aquatica by Ray and others; its ſtems and leaves float far on the water, and are often ſo matted together, as to bear a perſon walking on them. The male ſometimes lives in a ſeparate flower.

Sees his fair features paint the ſtreams that paſs,
And bends for ever o'er the watery glaſs.

*Two* brother ſwains, of Collin's gentle name,
The ſame their features, and their forms the ſame,
With rival love for fair Collinia ſigh,
Knit the dark brow, and roll the unſteady eye.
With ſweet concern the pitying beauty mourns,
And ſooths with ſmiles the jealous pair by turns.

Sweet blooms Genista in the myrtle ſhade,
And *ten* fond brothers woo the haughty maid.
*Two* knights before thy fragrant altar bend,
Adored Melissa! and *two* ſquires attend.

*Collinſonia.* l. 51. Two males, one female. I have lately obſerved a very ſingular circumſtance in this flower; the two males ſtand widely diverging from each other, and the female bends herſelf into contact firſt with one of them, and after ſome time leaves this, and applies herſelf to the other. It is probable one of the anthers may be mature before the other. See note on Glorioſa and Geniſta. The females in Nigella, devil in the buſh, are very tall compared to the males; and bending over in a circle to them, give the flower ſome reſemblance to a regal crown. The female of the Epilobium Auguſtifolium, roſe bay willow herb, bends down amongſt the males for ſeveral days, and becomes upright again when impregnated.

*Geniſta.* l. 57. Dyer's broom. Ten males and one female inhabit this flower. The males are generally united at the bottom in two ſets, whence Linnæus has named the claſs “two brotherhoods.” In the Geniſta, however, they are united in but one ſet. The flowers of this claſs are called papilionaceous, from their reſemblance to a butterfly, as a pea-bloſſom. In the Spartium Scoparium, or common broom, I have lately obſerved a curious circumſtance; the males, or ſtamens, are in two ſets, one ſet riſing a quarter of an inch above the other; the upper ſet does not arrive at their maturity ſo ſoon as the lower, and the ſtigma, or head of the female, is produced amongſt the upper or immature ſet; but as ſoon as the piſtil grows tall enough to burſt open the keel-leaf, or hood of the flower, it bends itſelf round in an inſtant, like a French horn, and inſerts its head, or ſtigma, amongſt the lower or mature ſet of males. The piſtil, or female, continues to grow in length; and in a few days the ſtigma arrives again amongſt the upper ſet, by the time they become mature. This wonderful contrivance is readily ſeen by opening the keel-leaf of the flowers of broom before they burſt ſpontaneouſly. See note on Collinſonia, Glorioſa, Draba.

*Meliſſa.* l. 60. Balm. In each flower there are four males and one female; two of the males ſtand higher than the other two; whence the name of the claſs “two powers.” I have obſerved in the Ballota, and others of this claſs, that the two lower ſtamens, or males, become mature before the two higher. After they have ſhed their duſt, they turn themſelves away outwards; and the piſtil, or female, continuing to grow a little taller, is applied to the upper ſtamens. See Glorioſa and Geniſta.

MEADIA's ſoft chains *five* ſuppliant beaux confeſs,
And, hand in hand, the laughing belle addreſs;
Alike to all, ſhe bows with wanton air,
Rolls her dark eye, and waves her golden hair.

Woo'd with long care, CURCUMA, cold and ſhy,
Meets her fond huſband with averted eye:

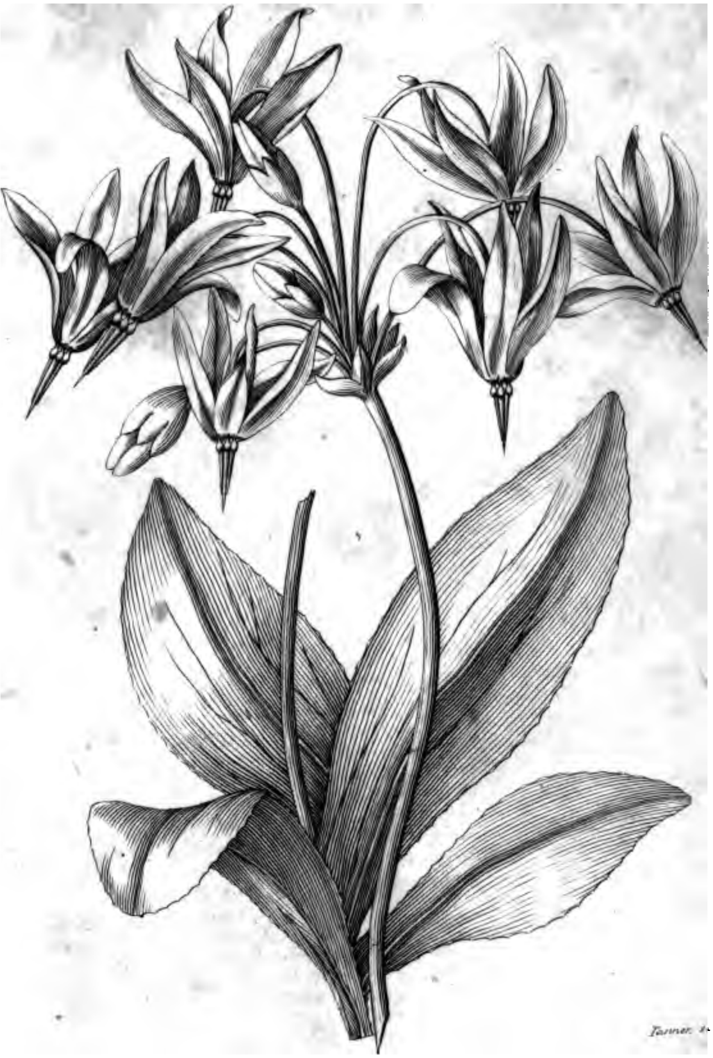
All the plants of this claſs, which have naked ſeeds, are aromatic. The Marum, and Nepeta are particularly delightful to cats; no other brute animals ſeem delighted with any odours but thoſe of their food or prey.

*Meadia*. l. 61. Dodecatheon, American Cowſlip. Five males and one female. The males, or anthers, touch each other. The uncommon beauty of this flower occaſioned Linnæus to give it a name ſignifying the twelve heathen gods; and Dr. Mead to affix his own name to it. The piſtil is much longer than the ſtamens; hence the flower-ſtalks have their elegant bend, that the ſtigma may hang downwards to receive the fecundating duſt of the anthers. And the petals are ſo beautifully turned back to prevent the rain or dew-drops from ſliding down and waſhing off this duſt prematurely; and at the ſame time expoſing it to the light and air. As ſoon as the ſeeds are formed, it erects all the flower-ſtalks to prevent them from falling out, and thus loſes the beauty of its figure. Is this a mechanical effect, or does it indicate a vegetable ſtorgé to preſerve its offspring? See note on Ilex, and Glorioſa.

In the Meadia, the Borago, Cyclamen, Solanum, and many others, the filaments are very ſhort compared with the ſtyle. Hence it became neceſſary, 1ſt. To furniſh the ſtamens with long anthers. 2d. To lengthen and bend the peduncle or flower-ſtalk, that the flower might hang downwards. 3d. To reflect the petals. 4th. To erect theſe peduncles when the germ was fecundated. We may reaſon upon this by obſerving, that all this apparatus might have been ſpared, if the filaments alone had grown longer; and that thence, in theſe flowers, that the filaments are the moſt unchangeable parts; and that thence their comparative length, in reſpect to the ſtyle, would afford a moſt permanent mark of their generic character.

*Curcuma*. l. 65. Turmeric. One male and one female inhabit this flower; but there are beſides four imperfect males, or filaments, without anthers upon them, called by Linnæus eunuchs. The flax of our country has ten filaments, and but five of them are terminated with anthers; the Portugal flax has ten perfect males, or ſtamens; the Verbena of our country has four males; that of Sweden has but two; the genus Albuca, the Bignonia Catalpa, Gratiola, and hemlock-leaved Geranium, have only half their filaments crowned with anthers. In like manner the florets, which form the rays of the flowers of the order fruſtraneous polygamy of the claſs ſyngeneſia, or confederate males, as the ſun-flower, are furniſhed with a ſtyle only, and no ſtigma, and are thence barren. There is alſo a ſtyle without a ſtigma in the whole order diœcia gynandria; the male flowers of which are thence barren. The Opulus is another plant which contains ſome unprolific flowers. In like manner ſome tribes of inſects have males, females, and neuters among them; as bees, waſps, ants.

There is a curious circumſtance belonging to the claſs of inſects which have two wings, or diptera, analogous to the rudiments of ſtamens above



Meadia.

Dodecatheon

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*Four* beardleſs youths the obdurate beauty move
With ſoft attentions of Platonic love.

With vain deſires the penſive ALCEA burns,
And, like ſad ELOISA, loves and mourns. 70
The freckled IRIS owns a fiercer flame,
And *three* unjealous huſbands wed the dame.
CUPRESSUS dark diſdains his duſky bride,
*One* dome contains them, but *two* beds divide.

deſcribed; viz. two little knobs are found placed, each on a ſtalk or peduncle, generally under a little arched ſcale; which appear to be rudiments of hinder wings; and are called by Linnæus halteres, or poiſers, a term of his introduction. A. T. Bladh. Amœn. Acad. V. 7. Other animals have marks of having, in a long proceſs of time, undergone changes in ſome parts of their bodies, which may have been effected to accommodate them to new ways of procuring their food. The exiſtence of teats on the breaſts of male animals, and which are generally replete with a thin kind of milk at their nativity, is a wonderful inſtance of this kind. Perhaps all the productions of nature are in their progreſs to greater perfection? an idea countenanced by the modern diſcoveries and deductions concerning the progreſſive formation of the ſolid parts of the terraqueous globe, and conſonant to the dignity of the Creator of all things.

*Alcea.* l. 69. Flore pleno. Double hollyhock. The double flowers, ſo much admired by the floriſts, are termed, by the botaniſt, vegetable monſters: in ſome of theſe the petals are multiplied three or four times, but without excluding the ſtamens; hence they produce ſome ſeeds, as Campanula and Stramonium; but in others the petals become ſo numerous as totally to exclude the ſtamens, or males, as Caltha, Peonia, and Alcea; theſe produce no ſeeds, and are termed eunuchs. Philoſ. Botan. No. 150.

Theſe vegetable monſters are formed in many ways:. 1ſt. By the multiplication of the petals, and the excluſion of the nectaries, as in larkſpur. 2d. By the multiplication of the nectaries, and excluſion of the petals, as in columbine. 3d. In ſome flowers growing in cymes, the wheel-ſhape flowers in the margin are multiplied to the excluſion of the bell-ſhape flowers in the centre, as in gelder-roſe. 4th. By the elongation of the florets in the centre. Inſtances of both theſe are found in daiſy and feverfew: for other kinds of vegetable monſters, ſee Plantago.

The perianth is not changed in double flowers; hence the genus, or family, may be often diſcovered by the calyx, as in Hepatica, Ranunculus, Alcea. In thoſe flowers which have many petals, the loweſt ſeries of the petals remains unchanged in reſpect to number; hence the natural number of the petals is eaſily diſcovered, as in poppies, roſes, and Nigella, or devil in a buſh. Phil. Bot. p. 128.

*Iris.* l. 71. Flower de Luce. Three males, one female. Some of the ſpecies have a beautifully freckled flower; the large ſtigma, or head of the female, covers the three males, counterfeiting a petal with its diviſions.

*Cupreſſus.* l. 73. Cypreſs. One houſe. The males live in ſeparate flowers, but on the ſame plant. The males of ſome of theſe plants, which are

The proud OSYRIS flies his angry fair,
*Two* houſes hold the faſhionable pair.

With ſtrange deformity PLANTAGO treads,
A monſter-birth! and lifts his hundred heads;
Yet with ſoft love a gentle belle he charms,
And claſps the beauty in his hundred arms.
So hapleſs DESDEMONA, fair and young,
Won by OTHELLO's captivating tongue,
Sigh'd o'er each ſtrange and piteous tale, diſtreſs'd,
And ſunk, enamour'd, on his ſooty breaſt.

in ſeparate flowers from the females, have an elaſtic membrane; which diſperſes their duſt to a conſiderable diſtance, when the anthers burſt open. This duſt, on a fine day, may often be ſeen like a cloud hanging round the common nettle. The males and females of all the cone-bearing plants are in ſeparate flowers, either on the ſame or on different plants; they produce reſins, and many of them are ſuppoſed to ſupply the moſt durable timber: what is called Venice-turpentine is obtained from the larch by wounding the bark about two feet from the ground, and catching it as it exſudes; Sandarach is procured from common juniper; and incenſe from a juniper with yellow fruit. The unperiſhable cheſts, which contain the Egyptian mummies, were of Cypreſs; and the Cedar, with which black-lead pencils are covered, is not liable to be eaten by worms. See Miln's Bot. Dict. art. coniferæ. The gates of St. Peter's church at Rome, which had laſted from the time of Conſtantine to that of Pope Eugene the Fourth, that is to ſay, eleven hundred years, were of Cypreſs, and had in that time ſuffered no decay. According to Thucydides, the Athenians buried the bodies of their heroes in coffins of Cypreſs, as being not ſubject to decay. A ſimilar durability has alſo been aſcribed to Cedar. Thus Horace,

————————*ſperamus carmina fingi*
*Poſſe linenda cedro & levi ſervanda cupreſſo.*

*Oſyris.* l. 75. Two houſes. The males and females are on different plants. There are many inſtances on record, where female plants have been impregnated at very great diſtance from their male; the duſt diſcharged from the anthers is very light, ſmall, and copious, ſo that it may ſpread very wide in the atmoſphere, and be carried to the diſtant piſtils, without the ſuppoſition of any particular attraction; theſe plants reſemble ſome inſects, as the ants, and cochineal inſect, of which the males have wings, but not the females.

*Plantago.* l. 77. Roſea. Roſe-Plantain. In this vegetable monſter the bractes, or diviſions of the ſpike, become wonderfully enlarged; and are converted into leaves. The chaffy ſcales of the calyx in Xeranthemum, and in a ſpecies of Dianthus, and the glume in ſome alpine graſſes, and the ſcales of the ament in the Salix Roſea, roſe-willow, grow into leaves; and produce other kinds of monſters. The double flowers become monſters by the multiplication of their petals or nectaries. See note on Alcea.

*Two* gentle ſhepherds, and their ſiſter-wives, 85
With thee, ANTHOXA! lead ambroſial lives;
Where the wide heath in purple pride extends,
And ſcatter'd furze its golden luſtre blends,
Cloſed in a green receſs, unenvy'd lot!
The blue ſmoak riſes from their turf-built cot; 90
Boſom'd in fragrance bluſh their infant train,
Eye the warm ſun, or drink the ſilver rain.

The fair OSMUNDA ſeeks the ſilent dell,
The ivy canopy, and dripping cell;
There, hid in ſhades, *clandeſtine* rites approves, 95
Till the green progeny betrays her loves.

With charms deſpotic fair CHONDRILLA reigns
O'er the ſoft hearts of *five* fraternal ſwains;

---

*Anthoxanthum.* l. 86. Vernal graſs. Two males, two females. The other graſſes have three males and two females. The flowers of this graſs give the fragrant ſcent to hay. I am informed it is frequently viviparous, that is, that it bears ſometimes roots or bulbs inſtead of ſeeds, which, after a time, drop off, and ſtrike root into the ground. This circumſtance is ſaid to obtain in many of the alpine graſſes, whoſe ſeeds are perpetually devoured by ſmall birds. The Feſtuca Dumetorum, feſcue graſs of the buſhes, produces bulbs from the ſheaths of its ſtraw. The Allium Magicum, or magical onion, produces onions on its head, inſtead of ſeeds. The Polygonum Viviparum, viviparous biſtort, riſes about a foot high, with a beautiful ſpike of flowers, which are ſucceeded by buds or bulbs, which fall off, and take root. There is a buſh frequently ſeen on birch-trees, like a bird's neſt, which ſeems to be a ſimilar attempt of nature, to produce another tree, which, falling off, might take root in ſpongy ground.

There is an inſtance of this double mode of production in the animal kingdom, which is equally extraordinary: the ſame ſpecies of Aphis is viviparous in ſummer, and oviparous in autumn. A. T. Bladh. Amœn. Acad. V. 7.

*Oſmunda.* l. 93. This plant grows on moiſt rocks; the parts of its flower or its ſeeds are ſcarce diſcernible; whence Linnæus has given the name of clandeſtine marriage to this claſs. The younger plants are of a beautiful vivid green.

*Chondrilla.* l. 97. Of the claſs Confederate Males. The numerous florets, which conſtitute the diſk of the flowers in this claſs, contain in each five males ſurrounding one female, which are connected at top, whence the name of the claſs. An Italian writer, in a diſcourſe on the irritability of flowers, aſſerts, that if the top of the floret be touched, all the filaments which ſupport the cylindrical anther will contract themſelves, and that, by thus raiſing or depreſſing the anther, the whole of the prolific duſt is col-

If ſighs the changeful nymph, alike they mourn;
And, if ſhe ſmiles, with rival raptures burn.
So, tun'd in uniſon, Eolian Lyre!
Sounds in ſweet ſymphony thy kindred wire;
Now, gently ſwept by Zephyr's vernal wings,
Sink in ſoft cadences the love-ſick ſtrings;
And now with mingling chords, and voices higher,
Peal the full anthems of the aerial choir.

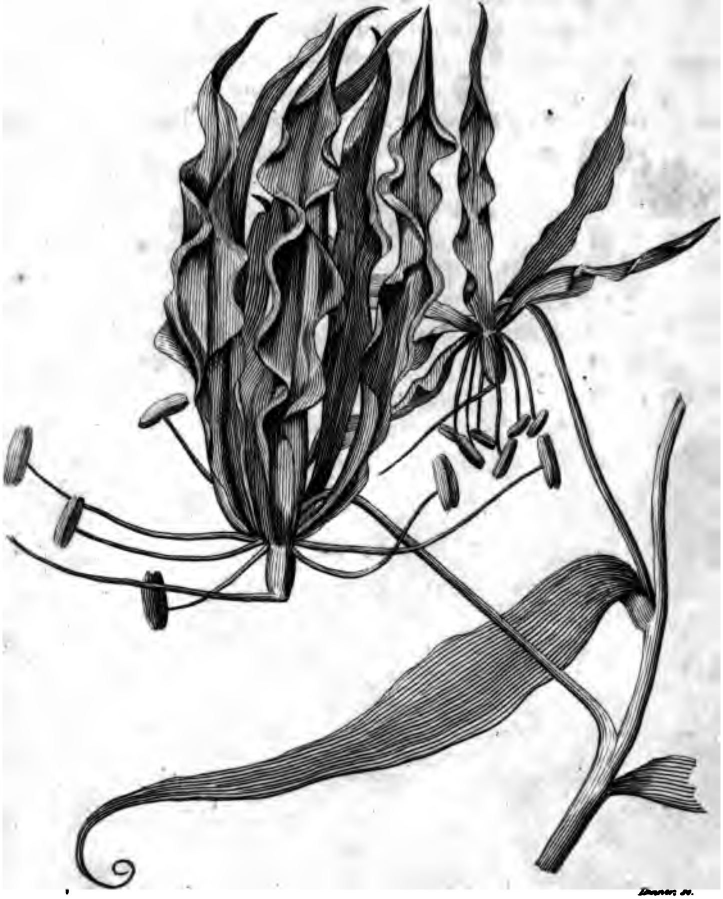
*Five* ſiſter-nymphs to join Diana's train
With thee, fair LYCHNIS! vow,—but vow in vain;
Beneath one roof reſides the virgin band,
Flies the fond ſwain, and ſcorns his offered hand;
But when ſoft hours on breezy pinions move,
And ſmiling May attunes her lute to love,
Each wanton beauty, trick'd in all her grace,
Shakes the bright dew-drops from her bluſhing face;
In gay undreſs diſplays her rival charms,
And calls her wondering lovers to her arms.

When the young Hours, amid her tangled hair,
Wove the freſh roſe-bud, and the lily fair,
Proud GLORIOSA led *three* choſen ſwains,
The bluſhing captives of her virgin chains—

lected on the ſtigma. He adds, that if one filament be touched after it is ſeparated from the floret, that it will contract like the muſcular fibres of animal bodies: his experiments were tried on the Centauréa Calcitrapoides, and on artichokes and globe-thiſtles. Diſcourſe on irritability of plants. Dodſley.

*Lychnis.* l. 108. Ten males and five females. The flowers which contain the five females, and thoſe which contain the ten males, are found on different plants, and often at a great diſtance from each other. Five of the ten males arrive at their maturity ſome days before the other five, as may be ſeen by opening the corol before it naturally expands itſelf. When the females arrive at their maturity, they riſe above the petals, as if looking abroad for their diſtant huſbands: the ſcarlet ones contribute much to the beauty of our meadows in May and June.

*Glorioſa.* l. 119. Superba. Six males, one female. The petals of this beautiful flower, with three of the ſtamens, which are firſt mature, ſtand up in apparent diſorder; and the piſtil bends at nearly a right angle, to inſert its ſtigma amongſt them. In a few days, as theſe decline, the other three ſtamens bend over, and approach the piſtil. In the Fritillaria Perſica, the ſix ſtamens are of equal lengths, and the anthers lie at a diſtance from



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Gloriosa Superba.

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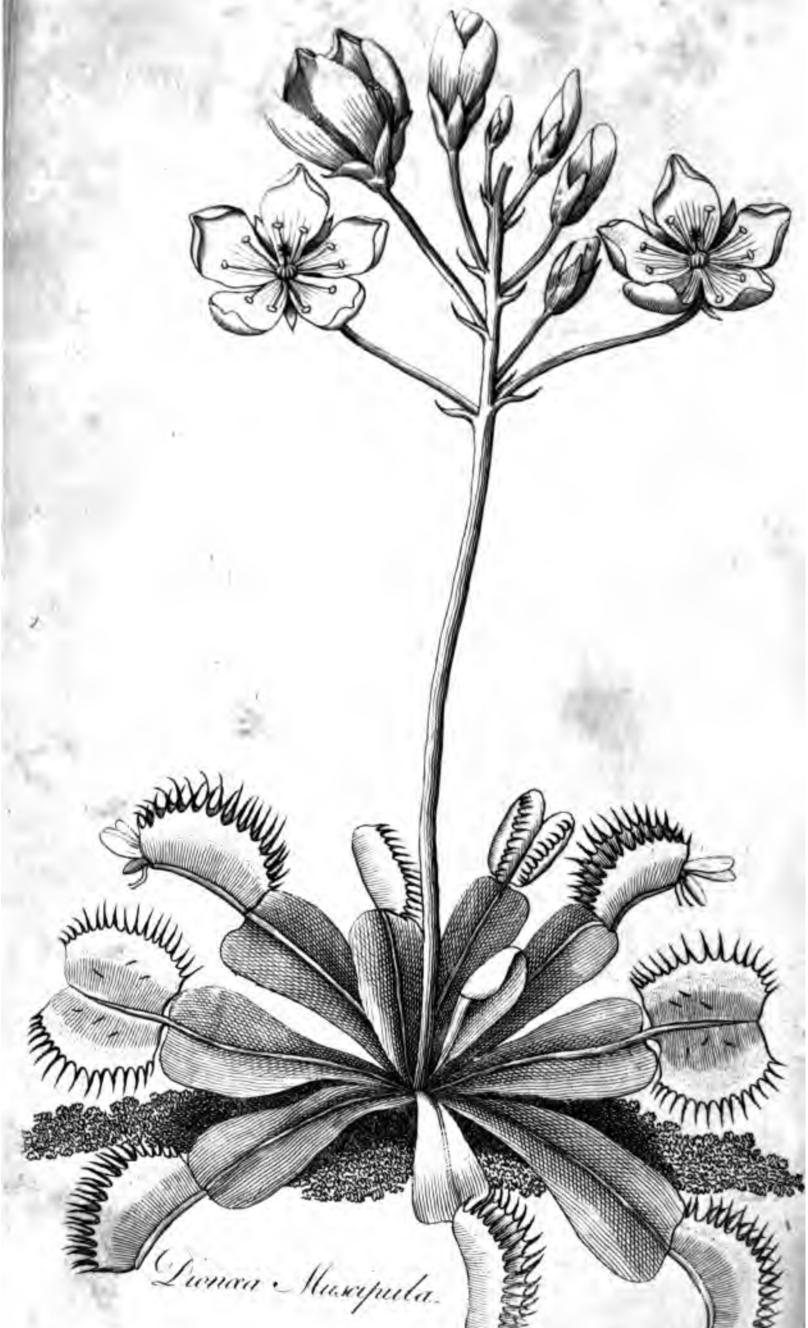


*Dionæa Muscipula.*

When Time's rude hand a bark of wrinkles ſpread
Round her weak limbs, and ſilver'd o'er her head,
*Three* other youths her riper years engage,
The flatter'd victims of her wily age.

So, in her wane of beauty, NINON won 125
With fatal ſmiles her gay unconſcious ſon.—
Claſp'd in his arms, ſhe own'd a mother's name,—
" Deſiſt, raſh youth! reſtrain your impious flame,
" Firſt on that bed your infant-form was preſs'd,
" Born by my throes, and nurtur'd at my breaſt."— 130
Back as from death he ſprung, with wild amaze
Fierce on the fair he fix'd his ardent gaze;
Dropp'd on one knee, his frantic arms outſpread,
And ſtole a guilty glance toward the bed;
Then breath'd from quivering lips a whiſper'd vow, 135
And bent on heaven his pale repentant brow;
" Thus, thus!" he cried, and plung'd the furious dart,
And life and love guſh'd, mingled, from his heart.

The fell SILENE, and her ſiſters fair,
Skill'd in deſtruction, ſpread the viſcous ſnare. 140

the piſtil, and three alternate ones approach firſt; and, when theſe decline, the other three approach: in the Lithrum Salicaria (which has twelve males and one female), a beautiful red flower, which grows on the banks of rivers, ſix of the males arrive at maturity, and ſurround the female ſome time before the other ſix; when theſe decline, the other ſix riſe up, and ſupply their places. Several other flowers have, in a ſimilar manner, two ſets of ſtamens of different ages, as Adoxa, Lychnis, Saxifraga. See Geniſta. Perhaps a difference in the time of their maturity obtains in all theſe flowers, which have numerous ſtamens. In the Kalmia, the ten ſtamens lie round the piſtil like the radii of a wheel; and each anther is concealed in a nich of the corol, to protect it from cold and moiſture; theſe anthers riſe ſeparately from their niches, and approach the piſtil for a time, and then recede to their former ſituations.

*Silene.* l. 139. Catchfly. Three females and ten males inhabit each flower; the viſcous material, which ſurrounds the ſtalks under the flowers of this plant, and of the Cucúbalus Otites, is a curious contrivance to prevent various inſects from plundering the honey, or devouring the ſeed. In the Dionæa Muſcipula there is a ſtill more wonderful contrivance to prevent the depredations of inſects: the leaves are armed with long teeth, like the antennæ of inſects, and lie ſpread upon the ground round the ſtem; and are ſo irritable, that when an inſect creeps upon them, they fold up,

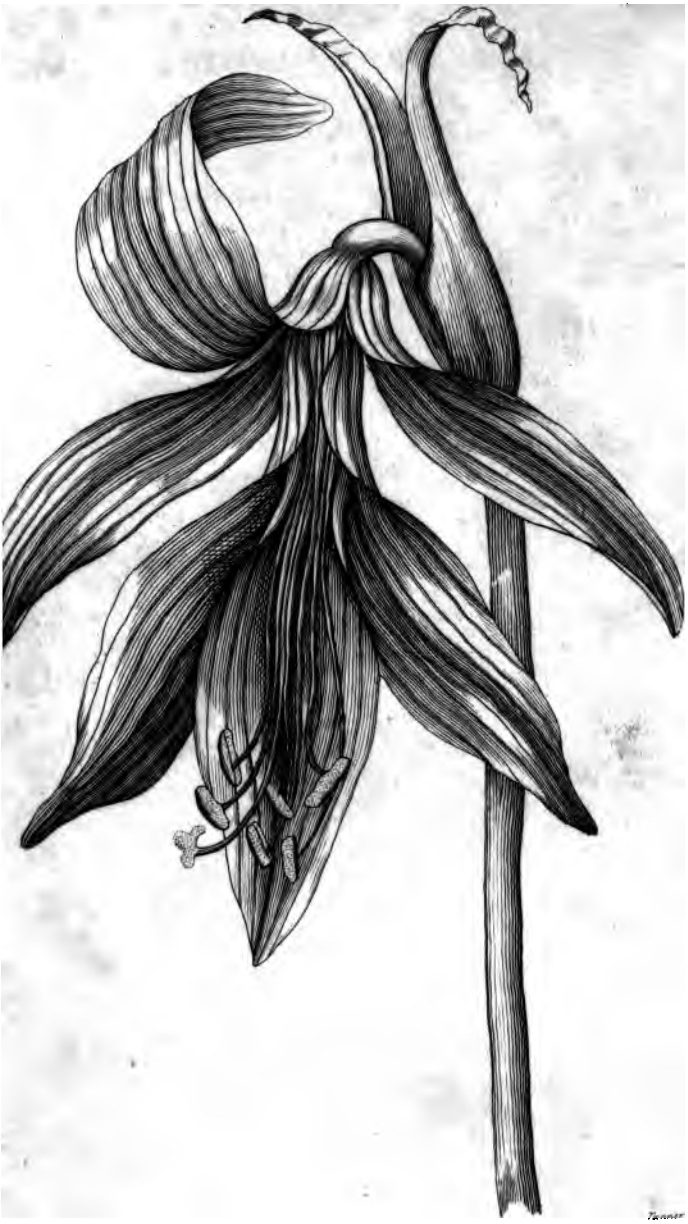
The harlot-band *ten* lofty bravoes ſcreen,
And, frowning, guard the magic nets unſeen.—
Haſte glittering nations, tenants of the air,
Oh, ſteer from hence your viewleſs courſe afar!
If with ſoft words, ſweet bluſhes, nods, and ſmiles,
The *three* dread Syrens lure you to their toils,
Limed by their art in vain you point your ſtings,
In vain the efforts of your whirring wings!—
Go, ſeek your gilded mates and infant hives,
Nor taſte the honey purchaſed with your lives!

When heaven's high vault condenſing clouds deform,
Fair AMARYLLIS flies the incumbent ſtorm.

and cruſh or pierce it to death. The laſt Profeſſor Linnæus, in his Supplementum Plantarum, gives the following account of the Arum Muſcivorum. The flower has the ſmell of carrion; by which the flies are invited to lay their eggs in the chamber of the flower, but, in vain, endeavour to eſcape, being prevented by the hairs pointing inwards, and thus periſh in the flower; whence its name of fly-eater. P. 411. In the Dypſacus is another contrivance for this purpoſe: a baſon of water is placed round each joint of the ſtem. In the Droſera is another kind of fly-trap. See Dypſacus and Droſera. The flowers of Silene and Cucúbalus are cloſed all day, but are open, and give an agreeable odour in the night. See Cerea. See additional notes at the end of the poem.

*Amaryllis.* l. 152. Formoſiſſima. Moſt beautiful Amaryllis. Six males, one female. Some of the bell-flowers cloſe their apertures at night, or in rainy or cold weather, as the convolvulus, and thus protect their included ſtamens and piſtils. Other bell-flowers hang their apertures downwards, as many of the lilies; in thoſe the piſtil, when at maturity, is longer than the ſtamens; and by this pendant attitude of the bell, when the anthers burſt, their duſt falls on the ſtigma; and theſe are, at the ſame time, ſheltered as with an umbrella from rain and dews. But, as a free expoſure to the air is neceſſary for their fecundation, the ſtyle and filaments in many of theſe flowers continue to grow longer after the bell is open, and hang down below its rim. In others, as in the Martagon, the bell is deeply divided, and the diviſions are reflected upwards, that they may not prevent the acceſs of air, and, at the ſame time, afford ſome ſhelter from perpendicular rain or dew. Other bell-flowers, as the Hemerocallis and Amaryllis, have their bells nodding only, as it were, or hanging obliquely towards the horizon; which, as their ſtems are ſlender, turn like a weathercock from the wind, and thus very effectually preſerve their incloſed ſtamens and anthers from the rain and cold. Many of theſe flowers, both before and after their ſeaſon of fecundation, erect their heads perpendicular to the horizon, like the Meadia, which cannot be explained from mere mechaniſm.

The Amaryllis Formoſiſſima is a flower of the laſt-mentioned kind, and affords an agreeable example of *art* in the vegetable economy. 1. The piſtil is of great length compared with the ſtamens; and this I ſuppoſe to have



Tanner sc.

Amaryllis formoſsima.

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Seeks with unſteady ſtep the ſhelter'd vale,
And turns her bluſhing beauties from the gale.—
*Six* rival youths, with ſoft concern impreſs'd,
Calm all her fears, and charm her cares to reſt.—
So ſhines at eve the ſun-illumin'd fane,
Lifts its bright croſs, and waves its golden vane;
From every breeze the poliſh'd axle turns,
And high in air the dancing meteor burns.

*Four* of the giant brood with Ilex ſtand,
Each graſps a thouſand arrows in his hand;

---

been the moſt unchangeable part of the flower, as in Meadia, which ſee. 2. To counteract this circumſtance, the piſtil and ſtamens are made to decline downwards, that the prolific duſt might fall from the anthers on the ſtigma. 3. To produce this effect, and to ſecure it when produced, the corol is lacerated, contrary to what occurs in other flowers of this genus, and the loweſt diviſion, with the two next loweſt ones, are wrapped cloſely over the ſtyle and filaments, binding them forcibly down lower towards the horizon, than the uſual inclination of the bell in this genus, and thus conſtitutes a moſt elegant flower. There is another contrivance for this purpoſe in the Hemerocallis Flava: the long piſtil often is bent ſomewhat like the capital letter *N*, with deſign to ſhorten it, and thus to bring the ſtigma amongſt the anthers.

*Ilex.* l. 161. Holly. Four males, four females. Many plants, like many animals, are furniſhed with arms for their protection; theſe are either aculei, prickles, as in roſe and barberry, which are formed from the outer bark of the plant; or ſpinæ, thorns, as in hawthorn, which are an elongation of the wood, and hence more difficult to be torn off than the former; or ſtimuli, ſtings, as in the nettles, which are armed with a venomous fluid for the annoyance of naked animals. The ſhrubs and trees which have prickles or thorns, are grateful food to many animals, as gooſeberry and gorſe; and would be quickly devoured if not thus armed; the ſtings ſeem a protection againſt ſome kinds of inſects, as well as the naked mouths of quadrupeds. Many plants loſe their thorns by cultivation, as wild animals loſe their ferocity, and ſome of them their horns. A curious circumſtance attends the large hollies in Needwood foreſt; they are armed with thorny leaves about eight feet high, and have ſmooth leaves above, as if they were conſcious that horſes and cattle could not reach their upper branches. See note on Meadia, and on Mancinella. The numerous clumps of hollies in Needwood foreſt ſerve as land-marks to direct the travellers acroſs it in various directions; and as a ſhelter to the deer and cattle in winter; and, in ſcarce ſeaſons, ſupply them with much food. For when the upper branches, which are without prickles, are cut down, the deer crop the leaves and peel off the bark. The bird-lime made from the bark of hollies ſeems to be a very ſimilar material to the elaſtic gum, or Indian rubber, as it is called. There is a foſſile elaſtic bitumen found at Matlock, in Derbyſhire, which much reſembles theſe ſubſtances in its elaſticity and inflammability. The thorns of the Mimoſa Cornigera reſemble cows' horns in appearance as well as in uſe. Syſtem of Vegetables, p. 782.

A thouſand ſteely points on every ſcale
Form the bright terrors of his briſtly mail.—
So arm'd, immortal Moore uncharm'd the ſpell,
And ſlew the wily dragon of the well.—
Sudden with rage their *injur'd* boſoms burn,
Retort the inſult, or the wound return;
*Unwrong'd*, as gentle as the breeze that ſweeps
The unbending harveſts or undimpled deeps,
They guard, the Kings of Needwood's wide domains,
Their ſiſter-wives and fair infantine trains;
Lead the lone pilgrim through the trackleſs glade,
Or guide in leafy wilds the wand'ring maid.

So Wright's bold pencil from Veſuvio's height
Hurls his red lavas to the troubled night;
From Calpè ſtarts the intolerable flaſh,
Skies burſt in flames, and blazing oceans daſh;—
Or bids in ſweet repoſe his ſhades recede,
Winds the ſtill vale, and ſlopes the velvet mead;
On the pale ſtream expiring Zephyrs ſink,
And Moonlight ſleeps upon its hoary brink.

Gigantic Nymph! the fair Kleinhovia reigns,
The grace and terror of Orixa's plains;
O'er her warm cheek the bluſh of beauty ſwims,
And nerves Herculean bend her ſinewy limbs;

---

*Hurls his red lavas.* l. 176. Alluding to the grand paintings of the eruptions of Veſuvius, and of the deſtruction of the Spaniſh veſſels before Gibraltar; and to the beautiful landſcapes, and moonlight ſcenes, by Mr. Wright, of Derby.

*Kleinhovia.* l. 183. In this claſs the males in each flower are ſupported by the female. The name of the claſs may be tranſlated "Viragoes," or "Feminine Males."

The largeſt tree perhaps in the world, is of the ſame natural order as Kleinhovia; it is the Adanſonia, or Ethiopian Sour-gourd, or African Calabaſh-tree. Mr. Adanſon ſays the diameter of the trunk frequently exceeds 25 feet, and the horizontal branches are from 45 to 55 feet long, and ſo large that each branch is equal to the largeſt trees of Europe. The breadth of the top is from 120 to 150 feet; and one of the roots bared only in part, by the waſhing away of the earth from the river, near which it grew, meaſured 110 feet long; and yet theſe ſtupendous trees never exceed 70 feet in height. Voyage to Senegal.

With frolic eye ſhe views the affrighted throng,
And ſhakes the meadows as ſhe towers along;
With playful violence diſplays her charms,
And bears her trembling lovers in her arms.
So fair THALESTRIS ſhook her plumy creſt,
And bound in rigid mail her jutting breaſt;
Poiſed her long lance amid the walks of war,
And Beauty thunder'd from Bellona's car;
Greece arm'd in vain, her captive heroes wove
The chains of conqueſt with the wreaths of love.

When o'er the cult[illegible]ur'd lawns and dreary waſtes
Retiring Autumn flings her howling blaſts,
Bends in tumultuous waves the ſtruggling woods,
And ſhowers their leafy honours on the floods,
In withering heaps collects the flowery ſpoil,
And each chill inſect ſinks beneath the ſoil;
Quick flies fair TULIPA the loud alarms,
And folds her infant cloſer in her arms;
In ſome lone cave, ſecure pavilion, lies,
And waits the courtſhip of ſerener ſkies.—
So, ſix cold moons, the Dormouſe charm'd to reſt,
Indulgent Sleep! beneath thy eider breaſt,

---

*Tulipa.* l. 203. Tulip. What is, in common language, called a bulbous-root, is, by Linnæus, termed the Hybernacle, or Winter-lodge of the young plant. As theſe bulbs, in every reſpect, reſemble buds, except in their being produced under ground, and include the leaves and flower in miniature, which are to be expanded in the enſuing ſpring. By cautiouſly cutting, in winter, through the concentric coats of a tulip-root, longitudinally from the top to the baſe, and taking them off ſucceſſively, the whole flower of the next ſummer's tulip is beautifully ſeen by the naked eye, with its petals, piſtil, and ſtamens; the flowers exiſt in other bulbs in the ſame manner as in Hyacinths; but the individual flowers of theſe being leſs, they are not ſo eaſily diſſected, or ſo conſpicuous to the naked eye.

In the ſeeds of the Nymphæa Nelumbo, the leaves of the plant are ſeen ſo diſtinctly, that Mr. Ferber found out by them to what plant the ſeeds belonged. Amœn. Acad. V. vi. No. 120. He ſays, that Mariotte firſt obſerved the future flower and foliage in the bulb of a tulip; and adds, that it is pleaſant to ſee in the buds of the Hepatica and Pedicularis hirſuta, yet lying in the earth; and in the gems of Daphne Mezereon; and at the baſe of Oſmunda Lunaria, a perfect plant of the future year, complete in all its parts. Ibid.

In fields of Fancy climbs the kernel'd groves,
Or ſhares the golden harveſt with his loves.— 210
Then bright from earth, amid the troubled ſky,
Aſcends fair Colchica with radiant eye,
Warms the cold boſom of the hoary year,
And lights with Beauty's blaze the duſky ſphere.
*Three* bluſhing Maids the intrepid Nymph attend, 215
And *ſix* gay Youths, enamour'd train! defend.
So ſhines with ſilver guards the Georgian ſtar,
And drives on Night's blue arch his glittering car;
Hangs o'er the billowy clouds his lucid form,
Wades thro' the miſt, and dances in the ſtorm. 220

Great Helianthus guides o'er twilight plains
In gay ſolemnity his Dervise-trains;
Marſhall'd in *fives* each gaudy band proceeds,
Each gaudy band a plumed Lady leads;

---

*Colchicum autumnale.* l. 212. Autumnal Meadow-ſaffron. Six males, three females. The germ is buried within the root, which thus ſeems to conſtitute a part of the flower. Families of Plants, p. 242. Theſe ſingular flowers appear in the autumn without any leaves, whence, in ſome countries, they are called Naked Ladies: in the March following the green leaves ſpring up, and in April the ſeed-veſſel riſes from the ground; the ſeeds ripen in May, contrary to the uſual habits of vegetables, which flower in the ſpring, and ripen their ſeeds in the autumn. Miller's Dict. The juice of the root of this plant is ſo acrid as to produce violent effects on the human conſtitution, which alſo prevents it from being eaten by ſubterranean inſects, and thus guards the ſeed-veſſel during the winter. The defoliation of deciduous trees is announced by the flowering of the Colchicum; of theſe the aſh is the laſt that puts forth its leaves, and the firſt that loſes them. Phil. Bot. p. 275.

The Hamamelis, Witch Hazel, is another plant which flowers in autumn; when the leaves fall off, the flowers come out in cluſters from the joints of the branches, and in Virginia ripen their ſeed in the enſuing ſpring, but in this country their ſeeds ſeldom ripen. Lin. Spec. Plant. Miller's Dict.

*Helianthus.* l. 221. Sun-flower. The numerous florets, which conſtitute the diſk of this flower, contain in each five males ſurrounding one female, the five ſtamens have their anthers connected at top, whence the name of the claſs "confederate males;" ſee note on Chondrilla. The ſunflower follows the courſe of the ſun by nutation, not by twiſting its ſtem. (Hale's Veg. Stat.) Other plants, when they are confined in a room, turn the ſhining ſurface of their leaves, and bend their whole branches to the light. See Mimoſa.

*A plumed Lady leads.* l. 224. The ſeeds of many plants of this claſs are furniſhed with a plume, by which admirable mechaniſm, they are diſſemi-

With zealous ſtep he climbs the upland lawn, 225
And bows in homage to the riſing dawn;
Imbibes with eagle eye the golden ray,
And watches, as it moves, the orb of day.

QUEEN of the marſh, imperial DROSERA treads
Ruſh-fringed banks, and moſs-embroider'd beds; 230
Redundant folds of gloſſy ſilk ſurround
Her ſlender waiſt, and trail upon the ground;
*Five* ſiſter-nymphs collect with graceful eaſe,
Or ſpread the floating purple to the breeze;
And *five* fair youths with duteous love comply 235
With each ſoft mandate of her moving eye.
As with ſweet grace her ſnowy neck ſhe bows,
A zone of diamonds trembles round her brows;
Bright ſhines the ſilver halo, as ſhe turns;
And, as ſhe ſteps, the living luſtre burns. 240

nated by the winds far from their parent ſtem, and look like a ſhuttlecock, as they fly. Other ſeeds are diſſeminated by animals; of theſe ſome attach themſelves to their hair or feathers by a gluten, as miſleto; others by hooks, as cleavers, burdock, hounds-tongue; and others are ſwallowed whole for the ſake of the fruit, and voided uninjured, as the hawthorn, juniper, and ſome graſſes. Other ſeeds again diſperſe themſelves by means of an elaſtic ſeed-veſſel, as oats, geranium, and impatiens; and the ſeeds of aquatic plants, and of thoſe which grow on the banks of rivers, are carried many miles by the currents, into which they fall. See Impatiens, Zoſtera, Caſſia, Carlina.

*Droſera.* l. 229. Sun-dew. Five males, five females. The leaves of this marſh-plant are purple, and have a fringe very unlike other vegetable productions. And, which is curious, at the point of every thread of this erect fringe ſtands a pellucid drop of mucilage, reſembling a ducal coronet. This mucus is a ſecretion from certain glands, and, like the viſcous material round the flower-ſtalks of Silene (catchfly) prevents ſmall inſects from infeſting the leaves. As the ear-wax, in animals, ſeems to be in part deſigned to prevent fleas and other inſects from getting into their ears. See Silene. Mr. Wheatley, an eminent ſurgeon in Cateaton-ſtreet, London, obſerved theſe leaves to bend upwards, when an inſect ſettled on them, like the leaves of the Muſcipula Veneris, and, pointing all their globules of mucus to the centre, that they completely intangled and deſtroyed it. M. Brouſſonet, in the Mem. de l'Acad. des Sciences, for the year 1784, p. 615. after having deſcribed the motion of the Dionæa, adds, that a ſimilar appearance has been obſerved in the leaves of two ſpecies of Droſera.

Fair Lonicera prints the dewy lawn,
And decks with brighter bluſh the vermil dawn;
Winds round the ſhadowy rocks, and panſied vales,
And ſcents with ſweeter breath the ſummer-gales;
With artleſs grace and native eaſe ſhe charms, 245
And bears the horn of plenty in her arms.
*Five* rival Swains their tender cares unfold,
And watch with eye aſkance the treaſured gold.

Where rears huge Tenerif his azure creſt,
Aſpiring Draba builds her eagle neſt; 250

*Lonicera.* l. 241. Caprifolium, Honeyſuckle. Five males, one female. Nature has, in many flowers, uſed a wonderful apparatus to guard the nectary, or honey-gland, from inſects. In the honeyſuckle the petal terminates in a long tube, like a cornucopiæ, or horn of plenty; and the honey is produced at the bottom of it. In Aconitum, monks-hood, the nectaries ſtand upright, like two horns covered with a hood, which abounds with ſuch acrid matter that no inſects penetrate it. In Helleborus, hellebore, the many nectaries are placed in a circle like little pitchers, and add much to the beauty of the flower. In the columbine, Aquilegia, the nectary is imagined to be like the neck and body of a bird, and the two petals ſtanding upon each ſide to repreſent wings; whence its name of columbine, as if reſembling a neſt of young pigeons fluttering whilſt their parent feeds them. The importance of the nectary in the economy of vegetation, is explained at large in the notes on part the firſt.

Many inſects are provided with a long and pliant proboſcis, for the purpoſe of acquiring this grateful food, as a variety of bees, moths, and butterflies; but the Sphinx Convolvuli, or unicorn moth, is furniſhed with the moſt remarkable proboſcis in this climate. It carries it rolled up in concentric circles under its chin, and occaſionally extends it to above three inches in length. This trunk conſiſts of joints and muſcles, and ſeems to have more verſatile movements than the trunk of the elephant; and near its termination is ſplit into two capillary tubes. The excellence of this contrivance for robbing the flowers of their honey, keeps this beautiful inſect fat and bulky, though it flies only in the evening, when the flowers have cloſed their petals, and are thence more difficult of acceſs; and, at the ſame time, the brilliant colours of the moth contribute to its ſafety, by making it miſtaken by the late ſleeping birds for the flower it reſts on.

Beſides theſe, there is a curious contrivance attending the Ophrys, commonly called the Bee-orchis, and the Fly-orchis, with ſome kinds of the Delphinium, called Bee-larkſpurs, to preſerve their honey; in theſe the nectary and petals reſemble, in form and colour, the inſects which plunder them; and thus it may be ſuppoſed, they often eſcape theſe hourly robbers, by having the appearance of being pre-occupied. See note on Rubia, and Conferva Polymorpha.

*Draba.* l. 250. Alpina. Alpine Whitlow-graſs. One female and ſix males. Four of theſe males ſtand above the other two; whence the name of the claſs "four powers." I have obſerved in ſeveral plants of this claſs,

Her pendant eyry icy caves ſurround,
Where erſt Volcanos mined the rocky ground.
Pleaſed round the Fair *four* rival Lords aſcend
The ſhaggy ſteeps, *two* menial youths attend.
High in the ſetting ray the beauty ſtands,
And her tall ſhadow waves on diſtant lands.

Oh! ſtay, bright habitant of air, alight,
Ambitious Visca, from thy angel-flight!—
—Scorning the ſordid ſoil, aloft ſhe ſprings,
Shakes her white plume, and claps her golden wings;
High o'er the fields of boundleſs ether roves,
And ſeeks amid the clouds her ſoaring loves!

Stretch'd on her moſſy couch, in trackleſs deeps,
Queen of the coral groves, Zostera ſleeps;

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that the two lower males ariſe, in a few days after the opening of the flower, to the ſame height as the other four, not being mature as ſoon as the higher ones. See note on Glorioſa. All the plants of this claſs poſſeſs ſimilar virtues; they are termed acrid and antiſcorbutic in their raw ſtate, as muſtard, watercreſs; when cultivated and boiled, they become a mild wholeſome food, as cabbage, turnip.

There was fromerly a volcano on the Peake of Teneriſ, which became extinct about the year 1684. Phil. Tranſ. In many excavations of the mountain, much below the ſummit, there is now found abundance of ice at all ſeaſons. Tench's Expedition to Botany-Bay, p. 12. Are theſe congelations in conſequence of the daily ſolution of the hoar-froſt, which is produced on the ſummit during the night?

*Viſcum*. l. 258. Miſletoe. Two houſes. This plant never grows upon the ground; the foliage is yellow, and the berries milk-white: the berries are ſo viſcous as to ſerve for bird-lime; and when they fall, adhere to the branches of the tree on which the plant grows, and ſtrike root into its bark, or are carried to diſtant trees by birds. The Tillandſia, or wild pine, grows on other trees, like the Miſletoe, but takes little or no nouriſhment from them, having large buckets in its leaves to collect and retain the rain-water. See note on Dypſacus. The moſſes, which grow on the bark of trees, take much nouriſhment from them; hence it is obſerved, that trees which are annually cleared from moſs by a bruſh, grow nearly twice as faſt. (Phil. Tranſ.) In the cyder countries the peaſants bruſh their apple-trees annually.

*Zoſtera*. l. 264. Graſs-wrack. Claſs, Feminine Males. Order, many Males. It grows at the bottom of the ſea, and, riſing to the ſurface when in flower, covers many leagues; and is driven, at length, to the ſhore. During its time of floating on the ſea, numberleſs animals live on the under ſurface of it; and, being ſpecifically lighter than the ſea-water, or being repelled by it, have legs placed, as it were, on their backs, for the purpoſe

The ſilvery ſea-weed matted round her bed, 265
And diſtant ſurges murmuring o'er her head.—
High in the flood her azure dome aſcends,
The cryſtal arch on cryſtal columns bends;
Roof'd with tranſlucent ſhell the turrets blaze,
And far in ocean dart their colour'd rays; 270
O'er the white floor ſucceſſive ſhadows move,
As riſe and break the ruffled waves above.—
Around the nymph her mermaid-trains repair,
And wave with orient pearl her radiant hair;
With rapid fins ſhe cleaves the watery way, 275
Shoots like a ſilver meteor up to day;
Sounds a loud conch, convokes a ſcaly band,
Her ſea-born lovers, and aſcends the ſtrand.

E'en round the pole the flames of Love aſpire,
And icy boſoms feel the *ſecret* fire!— 280
Cradled in ſnow, and fann'd by arctic air,
Shines, gentle BAROMETZ! thy golden hair;

of walking under it, as the Scyllœa. See Barbut's Genera Vermium. It ſeems neceſſary that the marriages of plants ſhould be celebrated in the open air, either becauſe the powder of the anther, or the mucilage on the ſtigma, or the reſervoir of honey, might receive injury from the water. Mr. Needham obſerved, that in the ripe duſt of every flower, examined by the microſcope, ſome veſicles are perceived, from which a fluid had eſcaped; and that thoſe which ſtill retain it, explode if they be wetted, like an eolopile ſuddenly expoſed to a ſtrong heat. Theſe obſervations have been verified by Spallanzani and others. Hence rainy ſeaſons make a ſcarcity of grain, or hinder its fecundity, by burſting the pollen before it arrives at the moiſt ſtigma of the flower. Spallanzani's Diſſertations, v. xi. p. 321. Thus the flowers of the male Valliſneria are produced under water, and, when ripe, detach themſelves from the plant, and, riſing to the ſurface, are wafted by the air to the female flowers. See Valliſneria.

*Barometz*. l. 282. Polypodium Barometz. Tartarian Lamb. Clandeſtine Marriage. This ſpecies of Fern is a native of China, with a decumbent root, thick, and every where covered with the moſt ſoft and denſe wool, intenſely yellow. Lin. Spec. Plant.

This curious ſtem is ſometimes puſhed out of the ground in its horizontal ſituation, by ſome of the inferior branches of the root, ſo as to give it ſome reſemblance to a Lamb ſtanding on four legs; and has been ſaid to deſtroy all other plants in its vicinity. Sir Hans Sloane deſcribes it under the name of Tartarian Lamb, and has given a print of it. Philoſ. Tranſ. abridged, v. xi. p. 646. but thinks ſome art had been uſed to give it an animal appearance. Dr. Hunter, in his edition of the Terra of Evelyn, has given a more curious print of it, much reſembling a ſheep. The down is uſed in India externally for ſtopping hæmorrhages, and is called golden moſs.

Rooted in earth each cloven hoof deſcends,
And round and round her flexile neck ſhe bends;
Crops the grey coral moſs, and hoary thyme, 285
Or laps with roſy tongue the melting rime;
Eyes with mute tenderneſs her diſtant dam,
Or ſeems to bleat, a *Vegetable Lamb.*
—So, warm and buoyant in his oily mail,
Gambols on ſeas of ice the unwieldy Whale; 290
Wide-waving fins round floating iſlands urge
His bulk gigantic through the troubled ſurge;
With hideous yawn the flying ſhoals he ſeeks,
Or claſps with fringe of horn his maſſy cheeks;
Lifts o'er the toſſing wave his noſtrils bare, 295
And ſpouts pellucid columns into air;
The ſilvery arches catch the ſetting beams,
And tranſient rainbows tremble o'er the ſtreams.

Weak with nice ſenſe, the chaſte MIMOSA ſtands,
From each rude touch withdraws her timid hands; 300

The thick downy clothing of ſome vegetables ſeems deſigned to protect them from the injuries of cold, like the wool of animals. Thoſe bodies, which are bad conductors of electricity, are alſo bad conductors of heat, as glaſs, wax, air. Hence, either of the two former of theſe may be melted by the flame of a blow-pipe very near the fingers which hold it, without burning them; and the laſt, by being confined on the ſurface of animal bodies, in the interſtices of their fur or wool, prevents the eſcape of their natural warmth; to which ſhould be added, that the hairs themſelves are imperfect conductors. The fat or oil of whales, and other northern animals, ſeems deſigned for the ſame purpoſe of preventing the too ſudden eſcape of the heat of the body in cold climates. Snow protects vegetables which are covered by it from cold, both becauſe it is a bad conductor of heat itſelf, and contains much air in its pores. If a piece of camphor be immerſed in a ſnow-ball, except one extremity of it, on ſetting fire to this, as the ſnow melts, the water becomes abſorbed into the ſurrounding ſnow by capillary attraction; on this account, when living animals are buried in ſnow, they are not moiſtened by it; but the cavity enlarges as the ſnow diſſolves, affording them both a dry and warm habitation.

*Mimoſa.* l. 299. The ſenſitive plant. Of the claſs Polygamy, one houſe. Naturaliſts have not explained the immediate cauſe of the collapſing of the ſenſitive plant; the leaves meet and cloſe in the night during the ſleep of the plant, or when expoſed to much cold in the day-time, in the ſame manner as when they are affected by external violence, folding their upper ſurfaces together, and in part over each other, like ſcales or tiles, ſo as to expoſe as little of the upper ſurface as may be to the air; but do not, indeed, collapſe quite ſo far, ſince I have found, when touched in the night during their ſleep,

Oft as light clouds o'er-paſs the Summer-glade,
Alarm'd ſhe trembles at the moving ſhade;
And feels, alive through all her tender form,
The whiſper'd murmurs of the gathering ſtorm;
Shuts her ſweet eye-lids to approaching night,
And hails with freſhen'd charms the riſing light.
Veil'd, with gay decency and modeſt pride,
Slow to the moſque ſhe moves an eaſtern bride;
There her ſoft vows unceaſing love record,
Queen of the bright ſeraglio of her Lord.—
So ſinks or riſes with the changeful hour
The liquid ſilver in its glaſſy tower.
So turns the needle to the pole it loves,
With fine librations quivering as it moves.

All wan and ſhivering in the leafleſs glade
The ſad ANEMONE reclined her head;
Grief on her cheeks had paled the roſeate hue,
And her ſweet eye-lids dropp'd with pearly dew.
—"See from bright regions, borne on odorous gales,
"The Swallow, herald of the ſummer, ſails;

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they fall ſtill further; eſpecially when touched on the foot-ſtalks between the ſtems and the leaflets, which ſeems to be their moſt ſenſitive or irritable part. Now, as their ſituation after being expoſed to external violence reſembles their ſleep, but with a greater degree of collapſe, may it not be owing to a numbneſs or paralyſis conſequent to too violent irritation, like the faintings of animals from pain or fatigue? I kept a ſenſitive plant in a dark room till ſome hours after day-break: its leaves and leaf-ſtalks were collapſed as in its moſt profound ſleep, and on expoſing it to the light, above twenty minutes paſſed before the plant was thoroughly awake and had quite expanded itſelf. During the night the upper or ſmoother ſurfaces of the leaves are appreſſed together; this would ſeem to ſhew that the office of this ſurface of the leaf was to expoſe the fluids of the plant to the light as well as to the air. See note on Helianthus. Many flowers cloſe up their petals during the night. See note on vegetable reſpiration in Part I.

*Anemone*. l. 316. Many males, many females. Pliny ſays this flower never opens its petals but when the wind blows; whence its name; it has properly no calix, but two or three ſets of petals, three in each ſet, which are folded over the ſtamens and piſtil in a ſingular and beautiful manner, and differs alſo from ranunculus in not having a melliferous pore on the claw of each petal.

*The Swallow*. l. 320. There is a wonderful conformity between the vegetation of ſome plants, and the arrival of certain birds of paſſage. Linnæus obſerves, that the wood anemone blows in Sweden on the arrival of the

"Breathe, gentle AIR! from cherub-lips impart
"Thy balmy influence to my anguiſh'd heart;
"Thou, whoſe ſoft voice calls forth the tender blooms,
"Whoſe pencil paints them, and whoſe breath perfumes;
"O chaſe the Fiend of Froſt, with leaden mace, 325
"Who ſeals in death-like ſleep my hapleſs race;
"Melt his hard heart, releaſe his iron hand,
"And give my ivory petals to expand.
"So may each bud, that decks the brow of ſpring,
"Shed all its incenſe on thy wafting wing!"— 330
To her fond prayer propitious Zephyr yields,
Sweeps on his ſliding ſhell through azure fields,

ſwallow; and the marſh mary-gold, Caltha, when the cuckoo ſings. Near the ſame coincidence was obſerved in England by Stillingfleet. The word Coccux in Greek ſignifies both a young fig and a cuckoo, which is ſuppoſed to have ariſen from the coincidence of their appearance in Greece. Perhaps a ſimilar coincidence of appearance in ſome part of Aſia gave occaſion to the ſtory of the love of the roſe and nightingale, ſo much celebrated by the eaſtern poets. See Dianthus. The times, however, of the appearance of vegetables in the ſpring ſeem occaſionally to be influenced by their acquired habits, as well as by their ſenſibility to heat; for the roots of potatoes, onions, &c. will germinate with much leſs heat in the ſpring than in the autumn; as is eaſily obſervable where theſe roots are ſtored for uſe; and hence malt is beſt made in the ſpring. 2d. The grains and roots brought from more ſouthern latitudes germinate here ſooner than thoſe which are brought from more northern ones, owing to their acquired habits. Fordyce on Agriculture. 3d. It was obſerved by one of the ſcholars of Linnæus, that the apple-trees ſent from hence to New-England bloſſomed for a few years too early for that climate, and bore no fruit; but afterwards learnt to accommodate themſelves to their new ſituation. (Kalm's Travels.) 4th. The parts of animals become more ſenſible to heat after having been previouſly expoſed to cold, as our hands glow on coming into the houſe after having held ſnow in them: this ſeems to happen to vegetables; for vines in grape-houſes, which have been expoſed to the winter's cold, will become forwarder and more vigorous than thoſe which have been kept during the winter in the houſe. (Kennedy on Gardening.) This accounts for the very rapid vegetation in the northern latitudes after the ſolution of the ſnows.

The increaſe of the irritability of plants in reſpect to heat, after having been previouſly expoſed to cold, is further illuſtrated by an experiment of Dr. Walker's. He cut apertures into a birch-tree at different heights; and on the 26th of March ſome of theſe apertures bled, or oozed with the ſap-juice, when the thermometer was at 39; which ſame apertures did not bleed on the 13th of March, when the thermometer was at 44. The reaſon of this, I apprehend, was, becauſe, on the night of the 25th the thermometer was as low as 34; whereas, on the night of the 12th it was at 41; though the ingenious author aſcribes it to another cauſe. Tranſ. of the Royal Soc. of Edinburgh, vol. i. p. 19.

O'er her fair manſion waves his whiſpering wand,
And gives her ivory petals to expand;
Gives with new life her filial train to riſe,
And hail with kindling ſmiles the genial ſkies.
So ſhines the Nymph in beauty's bluſhing pride,
When Zephyr wafts her deep calaſh aſide:
Tears with rude kiſs her boſom's gauzy veil,
And flings the fluttering kerchief to the gale.
So bright, the folding canopy undrawn,
Glides the gilt Landau o'er the velvet lawn,
Of beaux and belles diſplays the glittering throng,
And ſoft airs fan them, as they roll along.

Where frowning Snowden bends his dizzy brow
O'er Conway, liſtening to the ſurge below;
Retiring LICHEN climbs the topmoſt ſtone,
And drinks the aerial ſolitude alone.—
Bright ſhine the ſtars, unnumber'd, *o'er her head*,
And the cold moon-beam gilds her flinty bed;
While round the rifted rocks hoarſe whirlwinds breathe,
And dark with thunder ſail the clouds *beneath*.—
The ſteepy path her plighted ſwain purſues,
And tracks her light ſteps o'er the imprinted dews;
Delighted Hymen gives his torch to blaze,
Winds round the craggs, and lights the mazy ways;
Sheds o'er their ſecret vows his influence chaſte,
And decks with roſes the admiring waſte.

High in the front of heaven when Sirius glares,
And o'er Britannia ſhakes his fiery hairs:
When no ſoft ſhower deſcends, no dew diſtills,
Her wave-worn channels dry, and mute her rills;

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*Lichen*. l. 347. Calcareum. Liver-wort. Clandeſtine Marriage. This plant is the firſt that vegetates on naked rocks, covering them with a kind of tapeſtry, and draws its nouriſhment, perhaps, chiefly from the air; after it periſhes, earth enough is left for other moſſes to root themſelves; and after ſome ages, a ſoil is produced ſufficient for the growth of more ſucculent and large vegetables. In this manner, perhaps, the whole earth has been gradually covered with vegetation, after it was raiſed out of the primeval ocean by ſubterraneous fires.

When droops the ſickening herb, the bloſſom fades,
And parch'd earth gapes beneath the withering glades;
—With languid ſtep fair Dypsaca retreats,
"Fall, gentle dews!" the fainting nymph repeats,
Seeks the low dell, and in the ſultry ſhade
Invokes, in vain, the Naiads to her aid.—
*Four* ſylvan youths in cryſtal goblets bear
The untaſted treaſure to the grateful fair;
Pleaſed, from their hands with modeſt grace ſhe ſips,
And the cool wave reflects her coral lips.

With nice ſelection modeſt Rubia blends
Her vermil dyes, and o'er the cauldron bends;

*Dypſacus.* l. 365. Teaſel. One female and four males. There is a cup around every joint of the ſtem of this plant, which contains from a ſpoonful to half a pint of water; and ſerves both for the nutriment of the plant in dry ſeaſons, and to prevent inſects from creeping up to devour its ſeed. See Silene. The Tillandſia, or wild pine of the Weſt-Indies, has every leaf terminated near the ſtalk with a hollow bucket, which contains from half a pint to a quart of water. Dampier's Voyage to Campeachy. Dr. Sloane mentions one kind of aloe furniſhed with leaves, which, like the wild pine and Banana, hold water; and thence afford neceſſary refreſhment to travellers in hot countries. Nepenthes has a bucket, for the ſame purpoſe, at the end of every leaf. Burm. Zeyl. 42. 17.

*Rubia.* l. 373. Madder. Four males and one female. This plant is cultivated in very large quantities for dying red. If mixed with the food of young pigs or chickens, it colours their bones red. If they are fed alternate fortnights with a mixture of madder, and with their uſual food alone, their bones will conſiſt of concentric circles of white and red. Belchier. Phil. Tranſ. 1736. Animals fed with madder, for the purpoſe of theſe experiments, were found, upon diſſection, to have thinner gall. Comment. de rebus. Lipſiæ. This circumſtance is worth farther attention. The colouring materials of vegetables, like thoſe which ſerve the purpoſe of tanning, varniſhing, and the various medicinal purpoſes, do not ſeem eſſential to the life of the plant; but ſeem given it as a defence againſt the depredations of inſects, or other animals, to whom theſe materials are nauſeous or deleterious. The colours of inſects, and many ſmaller animals, contribute to conceal them from the larger ones which prey upon them. Caterpillars, which feed on leaves, are generally green; and earth-worms the colour of the earth which they inhabit; butterflies, which frequent flowers, are coloured like them; ſmall birds, which frequent hedges, have greeniſh backs like the leaves, and light coloured bellies like the ſky, and are hence leſs viſible to the hawk, who paſſes under them or over them. Thoſe birds which are much amongſt flowers, as the goldfinch (Fringilla Carduelis), are furniſhed with vivid colours. The lark, partridge, hare, are the colour of dry vegetables, or earth on which they reſt. And frogs vary their colour with the mud of the ſtreams which they frequent; and thoſe which live on trees are green. Fiſh, which are generally ſuſpended in water, and ſwallows,

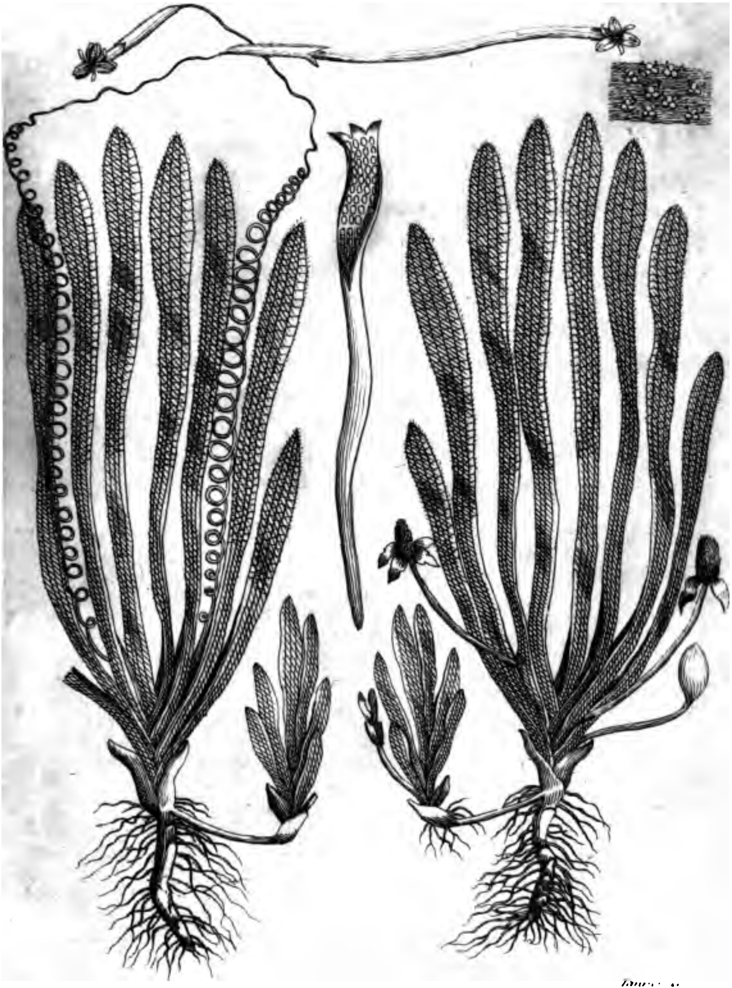
Warm, mid the riſing ſteam, the Beauty glows,
As bluſhes in a miſt the dewy roſe.
With chemic art *four* favour'd youths aloof
Stain the white fleece, or ſtretch the tinted woof;
O'er Age's cheek the warmth of youth diffuſe,
Or deck the pale-eyed nymph in roſeate hues.
So when MEDEA to exulting Greece
From plunder'd COLCHIS bore the golden fleece;
On the loud ſhore a magic pile ſhe rais'd,
The cauldron bubbled, and the faggots blaz'd;
Pleaſed, on the boiling wave old ÆSON ſwims,
And feels new vigour ſtretch his ſwelling limbs;
Through his thrill'd nerves forgotten ardors dart,
And warmer eddies circle round his heart;
With ſofter fires his kindling eye-balls glow,
And darker treſſes wanton round his brow.

As daſh the waves on India's breezy ſtrand,
Her fluſh'd cheek preſs'd upon her lily hand,
VALLISNER ſits, up-turns her tearful eyes,
Calls her loſt lover, and upbraids the ſkies;

which are generally ſuſpended in air, have their backs the colour of the diſtant ground, and their bellies of the ſky. In the colder climates many of theſe become white during the exiſtence of the ſnows. Hence there is apparent deſign in the colours of animals, whilſt thoſe of vegetables ſeem conſequent to the other properties of the materials which poſſeſs them.

*Pleaſed, on the boiling wave.* l. 385. The ſtory of Æſon becoming young, from the medicated bath of Medea, ſeems to have been intended to teach the efficacy of warm bathing in retarding the progreſs of old age. The words *relaxation and bracing*, which are generally thought expreſſive of the effects of warm and cold bathing, are mechanical terms, properly applied to drums or ſtrings; but are only metaphors when applied to the effects of cold or warm bathing on animal bodies. The immediate cauſe of old age ſeems to reſide in the inirritability of the finer veſſels, or parts of our ſyſtem; hence theſe ceaſe to act, and collapſe, or become horny or bony. The warm bath is peculiarly adapted to prevent theſe circumſtances by its increaſing our irritability, and by moiſtening and ſoftening the ſkin, and the extremities of the finer veſſels, which terminate in it. To thoſe who are paſt the meridian of life, and have dry ſkins, and begin to be emaciated, the warm bath, for half an hour twice a week, I believe to be eminently ſerviceable in retarding the advances of age.

*Vallisneria.* l. 393. This extraordinary plant is of the claſs Two Houſes. It is found in the Eaſt-Indies, in Norway, and various parts of Italy. Lin. Spec. Plant. They have their roots at the bottom of the Rhone; the flowers



Vallisneria Spiralis.

For him ſhe breathes the ſilent ſigh, forlorn, 395
Each ſetting day; for him each riſing morn.—
" Bright orbs, that light yon high etherial plain,
" Or bathe your radiant treſſes in the main;
" Pale moon, that ſilver'ſt o'er night's ſable brow;—
" For ye were witneſs to his parting vow! 400
" Ye ſhelving rocks, dark waves, and ſounding ſhore,—
" Ye echoed ſweet the tender words he ſwore!—
" Can ſtars or ſeas the ſails of love retain?
" O guide my wanderer to my arms again!"

Her buoyant ſkiff intrepid ULVA guides, 405
And ſeeks her Lord amid the trackleſs tides;

of the female plant float on the ſurface of the water, and are furniſhed with an elaſtic ſpiral ſtalk, which extends, or contracts, as the water riſes and falls. This riſe or fall, from the rapid deſcent of the river, and the mountain torrents which flow into it, often amounts to many feet in a few hours. The flowers of the male plant are produced under water, and as ſoon as their farina, or duſt, is mature, they detach themſelves from the plant, and riſe to the ſurface, continue to flouriſh, and are wafted by the air, or borne by the currents to the female flowers. In this reſembling thoſe tribes of inſects, where the males at certain ſeaſons acquire wings, but not the females, as ants, Coccus, Lampyris, Phalæna, Brumata, Lichanella. Theſe male flowers are in ſuch numbers, though very minute, as frequently to cover the ſurface of the river to conſiderable extent. See Families of Plants, tranſlated from Linnæus, p. 677.

*Ulva.* l. 405. Clandeſtine Marriage. This kind of ſea-weed is buoyed up by bladders of air, which are formed in the duplicatures of its leaves, and forms immenſe floating fields of vegetation; the young ones, branching out from the larger ones, and borne on ſimilar little air-veſſels. It is alſo found in the warm baths of Patavia; where the leaves are formed into curious cells or labyrinths, for the purpoſe of floating on the water. See ulva labyrinthi-formis Lin. Spec. Plant. The air contained in theſe cells was found by Dr. Prieſtley to be ſometimes purer than common air, and ſometimes leſs pure; the air-bladders of fiſh ſeem to be ſimilar organs, and ſerve to render them buoyant in the water. In ſome of theſe, as in the Cod and Haddock, a red membrane, conſiſting of a great number of leaves or duplicatures, is found within the air-bag, which probably ſecretes this air from the blood of the animal. (Monro. Phyſiol. of Fiſh, p. 28.) To determine whether this air, when firſt ſeparated from the blood of the animal or plant, be dephlogiſticated air, is worthy inquiry. The bladder-ſena (Colutea), and bladder-nut (Staphylæa), have their ſeed-veſſels diſtended with air; the Ketmia has the upper joint of the ſtem immediately under the receptacle of the flower, much diſtended with air: theſe ſeem to be analogous to the air-veſſel at the broad end of the egg, and may, probably, become leſs pure as the ſeed ripens: ſome, which I tried, had the purity of the ſurrounding atmoſphere. The air at the broad end of the egg is probably an organ ſerving the purpoſe of reſpiration to the young chick; ſome of whoſe veſſels are

Her *ſecret* vows the Cyprian Queen approves,
And hovering Halcyons guard her infant-loves;
Each in his floating cradle, round they throng,
And dimpling Ocean bears the fleet along.—
Thus o'er the waves, which gently bend and ſwell,
Fair GALATEA ſteers her ſilver ſhell;
Her playful Dolphins ſtretch the ſilken rein,
Hear her ſweet voice, and glide along the main.
As round the wild meandering coaſt ſhe moves
By guſhing rills, rude cliffs, and nodding groves;
Each by her pine, the Wood-nymphs wave their locks,
And wondering Naiads peep amid the rocks;
Pleaſed trains of Mermaids riſe from coral cells;
Admiring Tritons ſound their twiſted ſhells;
Charm'd o'er the car purſuing Cupids ſweep,
Their ſnow-white pinions twinkling in the deep;
And, as the luſtre of her eye ſhe turns,
Soft ſighs the Gale, and amorous Ocean burns,

On DOVE's green brink the fair TREMELLA ſtood,
And view'd her playful image in the flood;

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ſpread upon it like a placenta, or permeate it. Many are of opinion that even the placenta of the human fœtus, and cotyledons of quadrupeds, are reſpiratory organs rather than nutritious ones.

The air in the hollow ſtems of graſſes, and of ſome umbelliferous plants, bears analogy to the air in the quills, and in ſome of the bones of birds; ſupplying the place of the pith, which ſhrivels up after it has performed its office of protruding the young ſtem or feather. Some of theſe cavities of the bones are ſaid to communicate with the lungs in birds. Phil. Tranſ.

The air-bladders of fiſh are nicely adapted to their intended purpoſe; for though they render them buoyant near the ſurface, without the labour of uſing their fins, yet, when they reſt at greater depths, they are no inconvenience, as the increaſed preſſure of the water condenſes the air which they contain, into leſs ſpace. Thus, if a cork or bladder of air was immerſed a very great depth in the ocean, it would be ſo much compreſſed, as to become ſpecifically as heavy as the water, and would remain there. It is probable the unfortunate Mr. Day, who was drowned in a diving-ſhip of his own conſtruction, miſcarried from not attending to this circumſtance: it is probable the quantity of air he took down with him, if he deſcended much lower than he expected, was condenſed into ſo ſmall a ſpace as not to render the ſhip buoyant when he endeavoured to aſcend.

*Tremella*. l. 425. Clandeſtine marriage. I have frequently obſerved funguſſes of this Genus on old rails, and on the ground, to become a tranſparent jelly, after they had been frozen in autumnal mornings; which is a curious property, and diſtinguiſhes them from ſome other vegetable mucilage;

To each rude rock, lone dell, and echoing grove,
Sung the ſweet ſorrows of her *ſecret* love.
"Oh, ſtay!—return!"—along the ſounding ſhore
Cry'd the ſad Naiads,—ſhe return'd no more!— 430
Now girt with clouds the ſullen Evening frown'd,
And withering Eurus ſwept along the ground;
The miſty moon withdrew her horned light,
And ſunk with Heſper in the ſkirt of night;
No dim electric ſtreams, (the northern dawn) 435
With meek effulgence quiver'd o'er the lawn;
No ſtar benignant ſhot one tranſient ray
To guide or light the wanderer on her way.
Round the dark craggs the murmuring whirlwinds blow,
Woods groan above, and waters roar below; 440
As o'er the ſteeps with pauſing foot ſhe moves,
The pitying Dryads ſhriek amid their groves.
She flies—ſhe ſtops—ſhe pants—ſhe looks behind,
And hears a demon howl in every wind.
—As the bleak blaſt unfurls her fluttering veſt, 445
Cold beats the ſnow upon her ſhuddering breaſt;

for I have obſerved that the paſte made by boiling wheat-flour in water, ceaſes to be adheſive after having been frozen. I ſuſpected that the Tremella Noſtoc, or ſtar-jelly, alſo had been thus produced; but have ſince been well informed, that the Tremella Noſtoc is a mucilage voided by Herons after they have eaten frogs; hence it has the appearance of having been preſſed through a hole; and limbs of frogs are ſaid ſometimes to be found amongſt it: it is always ſeen upon plains, or by the ſides of water, places which Herons generally frequent.

Some of the funguſſes are ſo acrid, that a drop of their juice bliſters the tongue; others intoxicate thoſe who eat them. The Oſtiacks, in Siberia, uſe them for the latter purpoſe; one fungus of the ſpecies Agaricus Muſcarum, eaten raw, or the decoction of three of them, produces intoxication for 12 or 16 hours. Hiſtory of Ruſſia, vol. i. Nichols. 1780. As all acrid plants become leſs ſo, if expoſed to a boiling heat, it is probable the common muſhroom may ſometimes diſagree from being not ſufficiently ſtewed. The Oſtiacks bliſter their ſkin by a fungus found on Birch-trees; and uſe the Agaricus officin. for Soap. Ib.

There was a diſpute whether the funguſſes ſhould be claſſed in the animal or vegetable department. Their animal taſte in cookery, and their animal ſmell when burnt, together with their tendency to putrefaction, inſomuch that the Phallus impudicus has gained the name of ſtink-horn; and, laſtly, their growing and continuing healthy without light, as the Licoperdon tuber or truffle, and the fungus vinoſus or mucor in dark cellars, and the eſculent muſhrooms on beds covered thick with ſtraw, would ſeem to ſhew that they approach towards the animals, or make a kind of iſthmus, connecting the two mighty kingdoms of animal and of vegetable nature.

Through her numb'd limbs the chill ſenſations dart,
And the keen ice-bolt trembles at her heart.
"I ſink, I fall! oh, help me, help!" ſhe cries,
Her ſtiffening tongue the unfiniſhed ſound denies;
Tear after tear adown her cheek ſucceeds,
And pearls of ice beſtrew the glittering meads;
Congealing ſnows her lingering feet ſurround,
Arreſt her flight, and root her to the ground;
With ſuppliant arms ſhe pours the ſilent prayer;
Her ſuppliant arms hang cryſtal in the air;
Pellucid films her ſhivering neck o'erſpread,
Seal her mute lips, and ſilver o'er her head;
Veil her pale boſom, glaze her lifted hands,
And, ſhrined in ice, the beauteous ſtatue ſtands.
—Dove's azure nymphs, on each revolving year,
For fair Tremella ſhed the tender tear;
With ruſh-wove crowns in ſad proceſſion move,
And ſound the ſorrowing ſhell to hapleſs love."

Here pauſed the Muse,—acroſs the darken'd pole
Sail the dim clouds, the echoing thunders roll;
The trembling Wood-nymphs, as the tempeſt lowers,
Lead the gay Goddeſs to their inmoſt bowers;
Hang the mute lyre, the laurel ſhade beneath,
And round her temples bind the myrtle wreath.
—Now the light ſwallow, with her airy brood,
Skims the green meadow, and the dimpled flood;
Loud ſhrieks the lone thruſh from his leafleſs thorn,
Th' alarmed beetle ſounds his bugle horn;
Each pendant ſpider winds with fingers fine
His ravel'd clue, and climbs along the line;
Gay Gnomes in glittering circles ſtand aloof,
Beneath a ſpreading muſhroom's fretted roof;
Swift bees, returning, ſeek their waxen cells,
And Sylphs cling, quivering, in the lily's bells.
Through the ſtill air deſcend the genial ſhowers,
And pearly rain-drops deck the laughing flowers.

# INTERLUDE I.

*Bookseller.* YOUR verses, Mr. Botanist, consist of *pure description;* I hope there is *sense* in the notes.

*Poet.* I am only a flower-painter, or occasionally attempt a landskip; and leave the human figure, with the subjects of history, to abler artists.

*B.* It is well to know what subjects are within the limits of your pencil; many have failed of success from the want of this self-knowledge. But pray tell me, what is the essential difference between Poetry and Prose? is it solely the melody or measure of the language?

*P.* I think not solely; for some prose has its melody, and even measure. And good verses, well spoken in a language unknown to the hearer, are not easily to be distinguished from good prose.

*B.* Is it the sublimity, beauty, or novelty of the sentiments?

*P.* Not so; for sublime sentiments are often better expressed in prose. Thus when Warwick, in one of the plays of Shakespeare, is left wounded on the field, after the loss of the battle, and his friend says to him, " O, could you but fly!" what can be more sublime than this answer, " Why, then, I would not fly." No measure of verse, I imagine, could add dignity to this sentiment. And it would be easy to select examples of the beautiful or new from prose writers, which, I suppose, no measure of verse could improve.

*B.* In what, then, consists the essential difference between Poetry and Prose?

*P.* Next to the measure of the language, the principal distinction appears to me to consist in this: that Poetry admits of but few words expressive of very abstracted ideas, whereas Prose abounds with them. And as our ideas derived from visible objects are more distinct than those derived from the objects of our other senses, the words expressive of these ideas belonging to vision, make up the principal part of poetic language. That is, the Poet writes principally to the eye, the Prose writer uses more abstracted terms. Mr. Pope has written a bad verse in the Windsor Forest:

" And Kennet swift for silver Eels *renown'd*."

The word renown'd does not present the idea of a visible object to the mind, and is thnece prosaic. But change this line thus:

" And Kennet swift, where silver Graylings *play*,"

and it becomes poetry, because the scenery is then brought before the eye.

*B*. This may be done in prose.

*P*. And when it is done in a single word, it animates the prose; so it is more agreeable to read in Mr. Gibbon's History, " Germany was at this time *over-shadowed* with extensive forests," than Germany was at this time *full* of extensive forests. But where this mode of expression occurs too frequently, the prose approaches to poetry: and in graver works, where we expect to be instructed rather than amused, it becomes tedious and impertinent. Some parts of Mr. Burke's eloquent orations become intricate and enervated by superfluity of poetic ornament; which quantity of ornament would have been agreeable in a poem, where much ornament is expected.

*B*. Is, then, the office of Poetry only to amuse?

*P*. The Muses are young Ladies; we expect to see them dressed; though not like some modern beauties, with so much gauze and feather, that " the Lady herself is the least part of her." There are, however, didactic pieces of poetry, which are much admired, as the Georgics of Virgil, Mason's English Garden, Haley's Epistles; nevertheless, Science is best delivered in prose, as its mode of reasoning is from stricter analogies than metaphors or similies.

*B*. Do not Personifications and Allegories distinguish Poetry?

*P*. These are other arts of bringing objects before the eye; or of expressing sentiments in the language of vision; and are, indeed, better suited to the pen than the pencil.

*B*. That is strange, when you have just said they are used to bring their objects before the eye.

*P*. In Poetry the personification or allegoric figure is generally indistinct, and therefore does not strike us so forcibly as to make us attend to its improbability; but in painting, the figures being all much more distinct, their improbability becomes apparent, and seizes our attention to it. Thus the person of Concealment is very indistinct, and therefore does not compel us to attend to its improbability, in the following beautiful lines of Shakespeare:

> " —— She never told her love;
> But let Concealment, like a worm i' th' bud,
> Feed on her damask cheek."——

But in these lines below the person of Reason obtrudes itself into our company, and becomes disagreeable by its distinctness, and consequent improbability:

> " To Reason I flew, and intreated her aid,
> Who paused on my case, and each circumstance weigh'd;
> Then gravely reply'd, in return to my prayer,
> That Hebe was fairest of all that were fair.
> That's a truth, reply'd I, I've no need to be taught,
> I came to you, Reason, to find out a fault.
> If that's all, says Reason, return as you came,
> To find fault with Hebe would forfeit my name."

Allegoric figures are, on this account, in general, less manageable in painting and in statuary than in poetry; and can seldom be introduced in the two former arts in company with natural figures, as is evident from the ridiculous effect of many of the paintings of Rubens, in the Luxemburgh gallery; and for this reason, because their improbability becomes more striking, when there are the figures of real persons by their side to compare them with.

Mrs. Angelica Kauffman, well apprised of this circumstance, has introduced no mortal figures amongst her Cupids and her Graces. And the great Roubiliac, in his unrivalled monument of Time and Fame struggling for the trophy of General Wade, has only hung up a medallion of the head of the hero of the piece. There are, however, some allegoric figures, which we have so often heard described or seen delineated, that we almost forget that they do not exist in common life; and thence view them without astonishment; as the figures of the heathen mythology, of angels, devils, death, and time; and almost believe them to be realities, even when they are mixed with representations of the natural forms of man. Whence I conclude, that a certain degree of probability is necessary to prevent us from revolting with distaste from unnatural images, unless we are otherwise so much interested in the contemplation of them as not to perceive their improbability.

*B.* Is this reasoning about degrees of probability just?—When Sir Joshua Reynolds, who is unequalled both in the theory and practice of his art, and who is a great master of the pen as well as the pencil, has asserted, in a discourse delivered to the Royal Academy, December 11, 1786, that "the higher styles of painting, like the higher kinds of the Drama, do not aim at any thing like deception; or have any expectation that the spectators should think the events there represented as really passing before them." And he then accuses Mr. Fielding of bad judgment, when he attempts to compliment Mr. Garrick in one of his novels, by introducing an ignorant man, mistaking the representation of a scene in Hamlet for a reality; and thinks, because he was an ignorant man, he was less liable to make such a mistake.

*P.* It is a metaphysical question, and requires more attention than Sir Joshua has bestowed upon it.—You will allow that we are perfectly deceived in our dreams: and that even in our waking reveries, we are often so much absorbed in the contemplation of what passes in our imaginations, that, for a while, we do not attend to the lapse of time, or to our own locality; and thus suffer a similar kind of deception, as in our dreams. That is, we believe things present before our eyes, which are not so.

There are two circumstances which contribute to this complete deception in our dreams: First, because, in sleep, the organs of sense are closed or inert, and hence the trains of ideas associated in our imaginations are never interrupted or dissevered by the irritations of external objects, and cannot, therefore, be contrasted with our sensations. On this account, though we are affected with a variety of passions in our dreams, as anger, love, joy, yet we never experience surprize. For surprize is only produced when any external irritations suddenly obtrude themselves, and dissever our passing trains of ideas.

Secondly, because, in sleep, there is a total suspension of our voluntary power, both over the muscles of our bodies, and the ideas of our minds; for we neither walk about, nor reason in complete sleep. Hence, as the trains of our ideas are passing in our imaginations in dreams, we cannot compare them with our previous knowledge of things, as we do in our waking hours; for this is a voluntary exertion, and thus we cannot perceive their incongruity.

Thus we are deprived, in sleep, of the only two means by which we can distinguish the trains of ideas passing in our imaginations, from those excited by our sensations; and are led by their vivacity to believe them to belong to the latter. For the vivacity of these trains of ideas, passing in the imagination, is greatly increased by the causes above-mentioned; that is, by their not being disturbed or dissevered either by the appulses of external bodies, as in surprize, or by our voluntary exertions in comparing them with our previous knowledge of things, as in reasoning upon them.

*B.* Now to apply.

*P.* When, by the art of the Painter or Poet, a train of ideas is suggested to our imaginations, which interests us so much by the pain or pleasure it affords, that we cease to attend to the irritations of common external objects, and cease also to use any voluntary efforts to compare these interesting trains of ideas with our previous knowledge of things, a complete reverie is produced: during which time, however short, if it be but for a moment, the objects themselves appear to exist before us. This, I think, has been called, by an ingenious critic, "the ideal presence" of such objects. (Elements of Criticism, by Lord Kaimes.) And in respect to the compliment intended by Mr. Fielding to Mr. Garrick, it would seem that an ignorant rustic at the play of Hamlet, who has some previous belief in the appearance of Ghosts, would sooner be liable to fall into a reverie, and continue in it longer, than one who possessed more knowledge of the real nature of things, and had a greater facility of exercising his reason.

*B.* It must require great art in the Painter or Poet to produce this kind of deception.

*P.* The matter must be interesting from its sublimity, beauty, or novelty; this is the scientific part; and the art consists in bringing these distinctly before the eye, so as to produce (as above-mentioned) the ideal presence of the object, in which the great Shakespeare particularly excells.

*B.* Then it is not of any consequence whether the representations correspond with nature?

*P*. Not if they so much interest the reader or spectator as to induce the reverie above described. Nature may be seen in the market-place, or at the card-table; but we expect something more than this in the play-house or picture-room. The farther the artist recedes from nature, the greater novelty he is likely to produce; if he rises above nature, he produces the sublime; and beauty is probably a selection and new combination of her most agreeable parts. Yourself will be sensible of the truth of this doctrine, by recollecting over in your mind the works of three of our celebrated artists. Sir Joshua Reynolds has introduced sublimity even into its portraits; we admire the representation of persons, whose reality we should have passed by unnoticed. Mrs. Angelica Kauffman attracts our eyes with beauty, which, I suppose, no where exists; certainly few Grecian faces are seen in this country. And the daring pencil of Fuseli transports us beyond the boundaries of nature, and ravishes us with the charm of the most interesting novelty. And Shakespeare, who excells in all these together, so far captivates the spectator, as to make him unmindful of every kind of violation of time, place, or existence. As, at the first appearance of the Ghost of Hamlet, " his ear must be dull as the fat weed which roots itself on Lethe's brink," who can attend to the improbability of the exhibition. So, in many scenes of the Tempest, we perpetually believe the action passing before our eyes, and relapse, with somewhat of distaste, into common life, at the intervals of the representation.

*B*. I suppose a poet of less ability would find such great machinery difficult and cumbersome to manage?

*P*. Just so, we should be shocked at the apparent improbabilities. As in the gardens of a Sicilian nobleman, described in Mr. Brydone's and in Mr. Swinburne's travels, there are said to be six hundred statues of imaginary monsters, which so disgust the spectators, that the State had once a serious design of destroying them; and yet the very improbable monsters in Ovid's Metamorphoses have entertained the world for many centuries.

*B*. The monsters in your Botanic Garden, I hope, are of the latter kind?

*P*. The candid reader must determine.

# THE
# BOTANIC GARDEN.

## LOVES OF THE PLANTS.

## CANTO II.

AGAIN the Goddeſs ſtrikes the golden lyre,
And tunes to wilder notes the warbling wire;
With ſoft ſuſpended ſtep Attention moves,
And Silence hovers o'er the liſtening groves;
Orb within orb the charmed audience throng,
And the green vault reverberates the ſong.

"Breathe ſoft, ye Gales!" the fair CARLINA cries,
"Bear on broad wings your Votreſs to the ſkies.

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*Carlina.* l. 7. Carline Thiſtle. Of the claſs Confederate Males. The ſeeds of this and of many other plants of the ſame claſs are furniſhed with a plume, by which admirable mechaniſm they perform long aerial journeys, croſſing lakes and deſerts, and are thus diſſeminated far from the original plant, and have much the appearance of a Shuttlecock as they fly. The wings are of different conſtruction, ſome being like a divergent tuft of hairs, others are branched like feathers, ſome are elevated from the crown of the ſeed by a ſlender foot-ſtalk, which gives them a very elegant appearance, others ſit immediately on the crown of the ſeed.

Nature has many other curious vegetable contrivances for the diſperſion of ſeeds: ſee note on Helianthus. But perhaps none of them has more the appearance of deſign than the admirable apparatus of Tillandſia for this purpoſe. This plant grows on the branches of trees, like the miſletoe, and never on the ground; the ſeeds are furniſhed with many long threads on their crowns; which, as they are driven forwards by the winds, wrap round the arms of the trees, and thus hold them faſt till they vegetate. This is very analogous to the migration of Spiders on the goſſamer, who are ſaid to attach themſelves to the end of a long thread, and riſe thus to the tops of trees or buildings, as the accidental breezes carry them.

" How ſweetly mutable yon orient hues,
" As Morn's fair hand her opening roſes ſtrews;
" How bright, when Iris, blending many a ray,
" Binds in embroider'd wreath the brow of Day;
" Soft, when the pendant Moon with luſtres pale
" O'er heaven's blue arch unfurls her milky veil;
" While from the north long threads of ſilver light
" Dart on ſwift ſhuttles o'er the tiſſued night!
" Breathe ſoft, ye Zephyrs! hear my fervent ſighs,
" Bear on broad wings your Votreſs to the ſkies!"——
—Plume over plume in long divergent lines
On whale-bone ribs the fair Mechanic joins;
Inlays with eider down the ſilken ſtrings,
And weaves in wide expanſe Dædalian wings;
Round her bold ſons the waving pennons binds,
And walks with angel-ſtep upon the winds.

So on the ſhoreleſs air the intrepid Gaul
Launch'd the vaſt concave of his buoyant ball.—
Journeying on high, the ſilken caſtle glides
Bright as a meteor through the azure tides;
O'er towns, and towers, and temples, wins its way,
Or mounts ſublime, and gilds the vault of day.
Silent with upturn'd eyes unbreathing crowds
Purſue the floating wonder to the clouds;
And, fluſh'd with tranſport or benumb'd with fear,
Watch, as it riſes, the diminiſh'd ſphere.
—Now leſs and leſs!—and now a ſpeck is ſeen!—
And now the fleeting rack obtrudes between!—
With bended knees, raiſed arms, and ſuppliant brow,
To every ſhrine with mingled cries they vow.—
" Save Him, ye Saints! who o'er the good preſide;
" Bear Him, ye Winds! ye Stars benignant! guide."
—The calm Philoſopher in ether ſails,
Views broader ſtars, and breathes in purer gales;
Sees, like a map, in many a waving line,
Round Earth's blue plains her lucid waters ſhine;
Sees at his feet the forky lightnings glow,
And hears innocuous thunders roar below.

—Riſe, great Mongolfier! urge thy venturous flight
High o'er the Moon's pale ice-reflected light;
High o'er the pearly Star, whoſe beamy horn
Hangs in the eaſt, gay harbinger of morn;
Leave the red eye of Mars on rapid wing,
Jove's ſilver guards, and Saturn's cryſtal ring;
Leave the fair beams, which, iſſuing from afar,
Play with new luſtres round the Georgian ſtar;
Shun with ſtrong oars the Sun's attractive throne,
The ſparkling zodiac, and the milky zone;
Where headlong Comets, with increaſing force,
Through other ſyſtems bend their blazing courſe.—
For thee Caſſiope her chair withdraws,
For thee the Bear retracts his ſhaggy paws;
High o'er the North thy golden orb ſhall roll,
And blaze eternal round the wondering pole.
So Argo, riſing from the ſouthern main,
Lights with new ſtars the blue etherial plain;
With favouring beams the mariner protects,
And the bold courſe, which firſt it ſteer'd, directs.

Inventreſs of the Woof, fair Lina flings
The flying ſhuttle through the dancing ſtrings;
Inlays the broider'd weft with flowery dyes,
Quick beat the reeds, the pedals fall and riſe;
Slow from the beam the lengths of warp unwind,
And dance and nod the maſſy weights behind.—
Taught by her labours, from the fertile ſoil
Immortal Isis clothed the banks of Nile;

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*For thee the Bear.* l. 60. Tibi jam brachia contrahit ardens Scorpius. Virg. Georg. l. 1. 34. A new ſtar appeared in Caſſiope's chair in 1572. Herſchel's Conſtruction of the Heavens. Phil. Tranſ. vol. lxxv. p. 266.

*Linum.* l. 67. Flax. Five males and five females. It was firſt found on the banks of the Nile. The Linum Luſitanicum, or Portugal flax, has ten males: ſee the note on Curcuma. Iſis was ſaid to invent ſpinning and weaving: mankind before that time were clothed with the ſkins of animals. The fable of Arachne was to compliment this new art of ſpinning and weaving, ſuppoſed to ſurpaſs in fineneſs the web of the Spider.

And fair ARACHNE with her rival loom
Found undeſerved a melancholy doom.—
*Five* Siſter-nymphs with dewy fingers twine
The beamy flax, and ſtretch the fibre-line;
Quick eddying threads from rapid ſpindles reel,
Or whirl with beaten foot the dizzy wheel.
—Charm'd round the buſy Fair *five* ſhepherds preſs,
Praiſe the nice texture of their ſnowy dreſs,
Admire the Artiſts, and the art approve,
And tell with honey'd words the tale of love.

So now, where Derwent rolls his duſky floods
Through vaulted mountains, and a night of woods,
The Nymph, GOSSYPIA, treads the velvet ſod,
And warms with roſy ſmiles the watery God;
His ponderous oars to ſlender ſpindles turns,
And pours o'er maſſy wheels his foamy urns;
With playful charms her hoary lover wins,
And wields his trident,—while the Monarch ſpins.

*Goſſypia.* l. 87. Goſſypium. The cotton plant. On the river Derwent, near Matlock, in Derbyſhire, Sir RICHARD ARKWRIGHT has erected his curious and magnificent machinery for ſpinning cotton, which had been in vain attempted by many ingenious artiſts before him. The cotton-wool is firſt picked from the pods and ſeeds by women. It is then carded by *cylindrical cards*, which move againſt each other, with different velocities. It is taken from theſe by an *iron-band* or comb, which has a motion ſimilar to that of ſcratching, and takes the wool off the cards longitudinally in reſpect to the fibres or ſtaple, producing a continued line looſely cohering, called the *Rove* or *Roving*. This Rove, yet very looſely twiſted, is then received or drawn into a *whirling caniſter*, and is rolled by the centrifugal force in ſpiral lines within it; being yet too tender for the ſpindle. It is then paſſed between *two pairs of rollers*; the ſecond pair moving faſter than the firſt elongate the thread with greater equality than can be done by the hand; and is then twiſted on ſpoles or bobbins.

The great fertility of the Cotton-plant in theſe fine flexile threads, while thoſe from Flax, Hemp, and Nettles, or from the bark of the Mulberry-tree, require a previous putrefaction of the parenchymatous ſubſtance, and much mechanical labour, and afterwards bleaching, renders this plant of great importance to the world. And ſince Sir Richard Arkwright's ingenious machine has not only greatly abbreviated and ſimplified the labour and art of carding and ſpinning the Cotton-wool, but performs both theſe circumſtances *better* than can be done by hand, it is probable, that the clothing of this ſmall ſeed will become the principal clothing of mankind; though animal wool and ſilk may be preferable in colder climates, as they are more imperfect conductors of heat, and are thence a warmer clothing.

—Firſt with nice eye emerging Naiads cull
From leathery pods the vegetable wool;
With wiry teeth *revolving cards* releaſe
The tangled knots, and ſmooth the ravell'd fleece;
Next moves the *iron-hand* with fingers fine,
Combs the wide card, and forms the eternal line;
Slow, with ſoft lips, the *whirling Can* acquires
The tender ſkeins, and wraps in riſing ſpires;
With quicken'd pace *ſucceſſive rollers* move,
And theſe retain, and thoſe extend the *rove*;
Then fly the ſpoles, the rapid axles glow,
And ſlowly circumvolves the labouring wheel below.

Papyra, throned upon the banks of Nile,
Spread her ſmooth leaf, and waved her ſilver ſtyle.
—The ſtoried pyramid, the laurel'd buſt,
The trophy'd arch had crumbled into duſt;

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*Emerging Naiads.* l. 93. —— eam circum Mileſia vellera Nymphæ
Carpebant, hyali ſaturo fucata colore.
Virg. Georg. IV. 334.

*Cyperus. Papyrus.* l. 105. Three males, one female. The leaf of this plant was firſt uſed for paper, whence the word *paper;* and leaf, or folium, for a fold of a book. Afterwards the bark of a ſpecies of mulberry was uſed; whence *liber* ſignifies a book, and the bark of a tree. Before the invention of letters mankind may be ſaid to have been perpetually in their infancy, as the arts of one age or country generally died with their inventors. Whence aroſe the policy, which ſtill continues in Indoſtan, of obliging the ſon to practiſe the profeſſion of his father. After the diſcovery of letters, the facts of Aſtronomy and Chemiſtry became recorded in written language, though the ancient hieroglyphic characters for the planets and metals continue in uſe at this day. The antiquity of the invention of muſic, of aſtronomical obſervations, and the manufacture of Gold and Iron, are recorded in Scripture.

About twenty letters, ten cyphers, and ſeven crotchets, repreſent by their numerous combinations all our ideas and ſenſations! the muſical characters are probably arrived at their perfection, unleſs emphaſis, and tone, and ſwell could be expreſſed, as well as note and time. Charles the Twelfth of Sweden had a deſign to have introduced a numeration by ſquares, inſtead of by decimation, which might have ſerved the purpoſes of philoſophy better than the preſent mode, which is ſaid to be of Arabic invention. The Alphabet is yet in a very imperfect ſtate; perhaps ſeventeen letters could expreſs all the ſimple ſounds in the European languages. In China they have not yet learned to divide their words into ſyllables, and are thence neceſſitated to employ many thouſand characters; it is ſaid above eighty thouſand. It is to be wiſhed, in this ingenious age, that the European nations would accord to reform our alphabet.

The ſacred ſymbol, and the epic ſong,
(Unknown the character, forgot the tongue,) 110
With each unconquer'd chief, or ſainted maid,
Sunk undiſtinguiſh'd in Oblivion's ſhade.
Sad o'er the ſcatter'd ruins Genius ſigh'd,
And infant Arts but learn'd to liſp, and died.
Till to aſtoniſh'd realms Papyra taught 115
To paint in myſtic colours Sound and Thought.
With Wiſdom's voice to print the page ſublime,
And mark in adamant the ſteps of Time.
—*Three* favour'd youths her ſoft attention ſhare,
The fond diſciples of the ſtudious Fair, 120
Hear her ſweet voice, the golden proceſs prove;
Gaze. as they learn; and, as they liſten, love.
*The firſt* from Alpha to Omega joins
The letter'd tribes along the level lines;
Weighs with nice ear the vowel, liquid, ſurd, 125
And breaks in ſyllables the volant word.
Then forms *the next* upon the marſhall'd plain,
In deepening ranks, his dexterous cypher-train;
And counts, as wheel the decimating bands,
The dews of Egypt, or Arabia's ſands. 130
And then *the third*, on four concordant lines,
Prints the lone crotchet, and the quaver joins;
Marks the gay trill, the ſolemn pauſe inſcribes,
And parts with bars the undulating tribes. 134
Pleaſed, round her cane-wove throne, the applauding crowd
Clapp'd their rude hands, their ſwarthy foreheads bow'd;
With loud acclaim, "a preſent God!" they cry'd,
"A preſent God!" rebellowing ſhores reply'd.—
Then peal'd at intervals, with mingled ſwell,
The echoing harp, ſhrill clarion, horn, and ſhell; 140
While Bards ecſtatic, bending o'er the lyre,
Struck deeper chords, and wing'd the ſong with fire.
Then mark'd Aſtronomers, with keener eyes,
The Moon's refulgent journey through the ſkies;
Watch'd the ſwift Comets urge their blazing cars, 145
And weigh'd the Sun with his revolving Stars.

High raiſed the Chemiſts their Hermetic wands,
(And changing forms obey'd their waving hands,)
Her treaſured Gold from Earth's deep chambers tore,
Or fuſed and harden'd her chalybeate ore. 150
All with bent knee from fair PAPYRA claim,
Wove by her hands, the wreath of deathleſs fame.
—Exulting Genius crown'd his darling child,
The young Arts claſp'd her knees, and Virtue ſmil'd.

So now DELANY forms her mimic bowers, 155
Her paper foliage, and her ſilken flowers;
Her virgin train the tender ſciſſars ply,
Vein the green leaf, the purple petal dye:
Round wiry ſtems the flaxen tendril bends,
Moſs creeps below, and waxen fruit impends. 160
Cold Winter views, amid his realms of ſnow,
DELANY's vegetable ſtatues blow;
Smooths his ſtern brow, delays his hoary wing,
And eyes with wonder all the blooms of ſpring.

The gentle LAPSANA, NYMPHÆA fair, 165
And bright CALENDULA with golden hair,

*So now Delany.* l. 155. Mrs. Delany has finiſhed nine hundred and ſeventy accurate and elegant repreſentations of different vegetables, with the parts of their flowers, fructification, &c. according with the claſſification of Linnæus, in what ſhe terms paper-moſaic. She began this work at the age of 74, when her ſight would no longer ſerve her to paint, in which ſhe much excelled; between her age of 74 and 82, at which time her eyes quite failed her, ſhe executed the curious Hortus ſiccus above-mentioned, which I ſuppoſe contains a greater number of plants than were ever before drawn from the life by any one perſon. Her method conſiſted in placing the leaves of each plant with the petals, and all the other parts of the flowers, on coloured paper, and cutting them with ſciſſars accurately to the natural ſize and form, and then paſting them on a dark ground; the effect of which is wonderful, and their accuracy leſs liable to fallacy than drawings. She is at this time (1788) in her 89th year, with all the powers of a fine underſtanding ſtill unimpaired. I am informed another very ingenious lady, Mrs. North, is conſtructing a ſimilar Hortus ſiccus, or Paper-garden; which ſhe executes on a ground of vellum with ſuch elegant taſte and ſcientific accuracy, that it cannot fail to become a work of ineſtimable value.

*Lapſana, Nymphæa alba, Calendula.* l. 165. And many other flowers cloſe and open their petals at certain hours of the day; and thus conſtitute what Linnæus calls the Horologe, or Watch of Flora. He enumerates 46 flowers,

Watch with nice eye the Earth's diurnal way,
Marking her ſolar and ſidereal day,
Her ſlow nutation, and her varying clime,
And trace with mimic art the march of Time;
Round his light foot a magic chain they fling,
And count the quick vibrations of his wing.—
Firſt in its brazen cell reluctant roll'd,
Bends the dark ſpring in many a ſteely fold.
On ſpiral braſs is ſtretch'd the wiry thong,
Tooth urges tooth, and wheel drives wheel along;
In diamond-eyes the poliſh'd axles flow,
Smooth ſlides the hand, the balance pants below.
Round the white circlet, in relievo bold,
A Serpent twines his ſcaly length in gold;
And brightly pencil'd on the enamel'd ſphere,
Live the fair trophies of the paſſing year.
—Here *Time*'s huge fingers graſp his giant mace,
And daſh proud Superſtition from her baſe;

which poſſeſs this kind of ſenſibility. I ſhall mention a few of them, with their reſpective hours of riſing and ſetting, as Linnæus terms them. He divides them firſt into *meteoric* flowers, which leſs accurately obſerve the hour of unfolding, but are expanded ſooner or later, according to the cloudineſs, moiſture, or preſſure of the atmoſphere. 2d. *Tropical* flowers open in the morning and cloſe before evening every day; but the hour of the expanding becomes earlier or later, as the length of the day increaſes or decreaſes. 3dly. *Æquinoctial* flowers, which open at a certain and exact hour of the day, and for the moſt part cloſe at another determinate hour.

Hence the Horologe or Watch of Flora, is formed from numerous plants, of which the following are thoſe moſt common in this country. Leontodon taraxacum, Dandelion, opens at 5—6, cloſes at 8—9. Hieracium piloſella, mouſe-ear hawkweed, opens at 8, cloſes at 2. Sonchus lævis, ſmooth Sowthiſtle, at 5 and at 11—12. Lactuca ſativa, cultivated Lettice, at 7 and at 10. Tragopogon luteum, yellow Goats-beard, at 3—5 and at 9—10. Lapſana, nipplewort, at 5—6 and at 10—1. Nymphæa alba, white water lily, at 7 and 5. Papaver nudicaule, naked poppy, at 5 and at 7. Hemerocallis fulva, tawny Day-lily, at 5 and at 7—8. Convulvulus, at 5—6. Malva, Mallow, at 9—10, and at 1. Arenarea purpurea, purple Sandwort, at 9—10, and at 2—3. Anagallis, pimpernel, at 7—8. Portulaca hortenſis, garden Purſlain, at 9—10, and at 11—12. Dianthus prolifer, proliferous Pink, at 8 and at 1. Cichoreum, Succory, at 4—5. Hypochæris, at 6—7, and at 4—5. Crepis, at 4—5, and at 10—11. Picris, at 4—5, and at 12. Calendula field, at 9, and at 3. Calendula African, at 7, and at 3—4.

As theſe obſervations were probably made in the botanic gardens at Upſal, they muſt require farther attention to ſuit them to our climate. See Stillingfleet's Calendar of Flora.

Rend her ſtrong towers and gorgeous fanes, and ſhed 185
The crumbling fragments round her guilty head.
There the gay *Hours*, whom wreaths of roſes deck,
Lead their young trains amid the cumberous wreck,
And, ſlowly purpling o'er the mighty waſte,
Plant the fair growths of Science and of Taſte. 190
While each light *Moment*, as it dances by
With feathery foot and pleaſure-twinkling eye,
Feeds from its baby-hand, with many a kiſs,
The callow neſtlings of domeſtic Bliſs.

As yon gay clouds, which canopy the ſkies, 195
Change their thin forms, and loſe their lucid dyes;
So the ſoft bloom of Beauty's vernal charms
Fades in our eyes, and withers in our arms.
—Bright as the ſilvery plume, or pearly ſhell,
The ſnow-white roſe, or lily's virgin bell, 200
The fair Helleborus attractive ſhone,
Warm'd every Sage, and every Shepherd won.—
Round the gay ſiſters preſs the *enamour'd bands*,
And ſeek with ſoft ſolicitude their hands.
—Erewhile how chang'd!—in dim ſuffuſion lies 205
The glance divine, that lighten'd in their eyes;
Cold are thoſe lips, where ſmiles ſeductive hung,
And the weak accents linger on their tongue;
Each roſeate feature fades to livid green—
—Diſguſt, with face averted, ſhuts the ſcene. 210

So from his gorgeous throne, which awed the world,
The mighty Monarch of Aſſyria hurl'd,

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*Helleborus*. l. 201. Many males, many females. The Helleborus niger, or Chriſtmas roſe, has a large beautiful white flower, adorned with a circle of tubular two-lip'd nectaries. After impregnation the flower undergoes a remarkable change, the nectaries drop off, but the white corol remains, and gradually becomes quite green. This curious metamorphoſe of the corol, when the nectaries fall off, ſeems to ſhew that the white juices of the corol were before carried to the nectaries, for the purpoſe of producing honey: becauſe when theſe nectaries fall off, no more of the white juice is ſecreted in the corol, but it becomes green, and degenerates into a calyx. See note on Lonicera. The nectary of the Tropæolum, garden naſturtium, is a coloured horn growing from the calyx.

Sojourn'd with brutes beneath the midnight ſtorm,
Changed by avenging Heaven in mind and form.
—Prone to the earth he bends his brow ſuperb,
Crops the young floret and the bladed herb;
Lolls his red tongue, and from the reedy ſide
Of ſlow Euphrates laps the muddy tide.
Long eagle plumes his arching neck inveſt,
Steal round his arms, and claſp his ſharpen'd breaſt;
Dark brinded hairs, in briſtling ranks, behind,
Riſe o'er his back, and ruſtle in the wind;
Clothe his lank ſides, his ſhrivel'd limbs ſurround,
And human hands with talons print the ground.
Silent, in ſhining troops, the Courtier-throng
Purſue their monarch as he crawls along;
E'en Beauty pleads in vain with ſmiles and tears,
Nor Flattery's ſelf can pierce his pendant ears.

*Two* Siſter-Nymphs to Ganges' flowery brink
Bend their light ſteps, the lucid water drink,
Wind through the dewy rice, and nodding canes,
(As *eight* black Eunuchs guard the ſacred plains,)
With playful malice watch the ſcaly brood,
And ſhower the inebriate berries on the flood.—
Stay in your cryſtal chambers, ſilver tribes!
Turn your bright eyes, and ſhun the dangerous bribes;
The tramel'd net with leſs deſtruction ſweeps
Your curling ſhallows, and your azure deeps;
With leſs deceit, the gilded fly beneath,
Lurks the fell hook unſeen,—to taſte is death!
—Dim your ſlow eyes, and dull your pearly coat,
Drunk on the waves your languid forms ſhall float,
On uſeleſs fins in giddy circles play,
And Herons and Otters ſeize you for their prey.—

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*Two Siſter-Nymphs*. l. 229. Meniſpermum. Coccelus. Indian berry. Two houſes, twelve males. In the female flower there are two ſtyles and eight filaments without anthers on their ſummits; which are called by Linnæus eunuchs. See the note on Curcuma. The berry intoxicates fiſh. Saint Anthony of Padua, when the people refuſed to hear him, preached to the fiſh, and converted them. Addiſon's travels in Italy.

So, when the Saint from Padua's graceleſs land 245
In ſilent anguiſh ſought the barren ſtrand,
High on the ſhatter'd beech ſublime he ſtood,
Still'd with his waving arm the babbling flood;
"To Man's dull ear," he cry'd, "I call in vain,
"Hear me, ye ſcaly tenants of the main!—" 250
Miſhapen Seals approach in circling flocks,
In duſky mail the Tortoiſe climbs the rocks,
Torpedoes, Sharks, Rays, Porpus, Dolphins, pour
Their twinkling ſquadrons round the glittering ſhore;
With tangled fins, behind, huge Phocæ glide, 255
And Whales and Grampi ſwell the diſtant tide.
Then kneel'd the hoary Seer, to Heav'n addreſs'd
His fiery eyes, and ſmote his ſounding breaſt;
"Bleſs ye the Lord," with thundering voice he cry'd,
"Bleſs ye the Lord!" the bending ſhores reply'd; 260
The winds and waters caught the ſacred word,
And mingling echoes ſhouted "Bleſs the Lord!"
The liſtening ſhoals the quick contagion feel,
Pant on the floods, inebriate with their zeal,
Ope their wide jaws, and bow their ſlimy heads, 265
And daſh with frantic fins their foamy beds.

Sopha'd on ſilk, amid her charm-built towers,
Her meads of aſphodel, and amaranth bowers,
Where Sleep and Silence guard the ſoft abodes,
In ſullen apathy Papaver nods. 270

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*Papaver.* l. 270. Poppy. Many males, many females. The plants of this claſs are almoſt all of them poiſonous; the fineſt opium is procured by wounding the heads of large poppies with a three-edged knife, and tying muſcle-ſhells to them to catch the drops. In ſmall quantities it exhilarates the mind, raiſes the paſſions, and invigorates the body: in large ones it is ſucceeded by intoxication, languor, ſtupor and death. It is cuſtomary in India for a meſſenger to travel above a hundred miles without reſt or food, except an appropriated bit of opium for himſelf, and a larger one for his horſe at certain ſtages. The emaciated and decrepid appearance, with the ridiculous and idiotic geſtures, of the opium-eaters in Conſtantinople, is well deſcribed in the Memoirs of Baron de Tott.

Faint o'er her couch in ſcintillating ſtreams
Paſs the thin forms of Fancy and of Dreams;
Froze by inchantment on the velvet ground,
Fair youths and beauteous ladies glitter round;
On cryſtal pedeſtals they ſeem to ſigh,
Bend the meek knee, and lift the imploring eye.
—And now the Sorcereſs bares her ſhrivel'd hand,
And circles thrice in air her ebon wand;
Fluſh'd with new life deſcending ſtatues talk,
The pliant marble ſoftening as they walk;
With deeper ſobs reviving lovers breathe,
Fair boſoms riſe and ſoft hearts pant beneath;
With warmer lips relenting damſels ſpeak,
And kindling bluſhes tinge the Parian cheek;
To viewleſs lutes aerial voices ſing,
And hovering loves are heard on ruſtling wing.
—She waves her wand again!—freſh horrors ſeize
Their ſtiffening limbs, their vital currents freeze;
By each cold nymph her marble lover lies,
And iron ſlumbers ſeal her glaſſy eyes.
So with his dread Caduceus HERMES led
From the dark regions of the impriſon'd dead,
Or drove in ſilent ſhoals the lingering train
To Night's dull ſhore, and PLUTO's dreary reign.

So with her waving pencil CREWE commands
The realms of Taſte, and Fancy's fairy lands;
Calls up with magic voice the ſhapes, that ſleep
In Earth's dark boſom, or unfathom'd deep;
That, ſhrined in air, on viewleſs wings aſpire,
Or, blazing, bathe in elemental fire.
As with nice touch her plaſtic hand ſhe moves,
Riſe the fine forms of Beauties, Graces, Loves;
Kneel to the fair Inchantreſs, ſmile or ſigh,
And fade or flouriſh, as ſhe turns her eye.

*So with her waving pencil.* l. 295. Alluding to the many beautiful paintings by Miſs EMMA CREWE.

Fair CISTA, rival of the roſy dawn, 305
Call'd her light choir, and trod the dewy lawn;
Hail'd with rude melody the new-born May,
As cradled yet in April's lap ſhe lay.

I.

"Born in yon blaze of orient ſky,
"Sweet MAY! thy radiant form unfold; 310
"Uncloſe thy blue voluptuous eye,
"And wave thy ſhadowy locks of gold.

II.

"For thee the fragrant zephyrs blow,
"For thee deſcends the ſunny ſhower;
"The rills in ſofter murmurs flow, 315
"And brighter bloſſoms gem the bower.

III.

"Light Graces dreſs'd in flowery wreaths,
"And tiptoe Joys their hands combine;
"And Love his ſweet contagion breathes,
"And laughing dances round thy ſhrine. 320

IV.

"Warm with new life the glittering throngs,
"On quivering fin and ruſtling wing,
"Delighted join their votive ſongs,
"And hail thee, GODDESS OF THE SPRING."

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*Ciſtus labdaniferus.* l. 305. Many males, one female. The petals of this beautiful and fragrant ſhrub, as well as of the Œnothera, tree primroſe, and others, continue expanded but a few hours, falling off about noon, or ſoon after, in hot weather. The moſt beautiful flowers of the Cactus grandiflorus (ſee Cerea) are of equally ſhort duration, but have their exiſtence in the night. And the flowers of the Hibiſcus trionum are ſaid to continue but a ſingle hour. The courtſhip between the males and females in theſe flowers might be eaſily watched; the males are ſaid to approach and recede from the females alternately. The flowers of the Hibiſcus ſinenſis, mutable roſe, live in the Weſt-Indies, their native climate, but one day; but have this remarkable property, they are white at their firſt expanſion, then change to deep red, and become purple as they decay.

The gum or reſin of this fragrant vegetable is collected from extenſive underwoods of it in the Eaſt by a ſingular contrivance. Long leathern thongs are tied to poles and cords, and drawn over the tops of theſe ſhrubs about noon; which thus collect the duſt of the anthers, which adheres to the leather, and is occaſionally ſcraped off. Thus, in ſome degree, is the manner imitated, in which the bee collects on his thighs and legs the ſame material for the conſtruction of his combs.

O'er the green brinks of Severn's oozy bed,
In changeful rings, her ſprightly troops ſhe led;
PAN tripp'd before, where Eudneſs ſhades the mead,
And blew with glowing lip his ſevenfold reed;
Emerging Naiads ſwell'd the jocund ſtrain,
And aped with mimic ſtep the dancing train.—
"I faint, I fall!"—*at noon* the Beauty cried,
"Weep o'er my tomb, ye Nymphs!"—and ſunk, and died.
—Thus, when white Winter o'er the ſhivering clime
Drives the ſtill ſnow, or ſhowers the ſilver rime;
As the lone ſhepherd o'er the dazzling rocks
Prints his ſteep ſtep, and guides his vagrant flocks;
Views the green holly veil'd in net-work nice,
Her vermil cluſters twinkling in the ice;
Admires the lucid vales, and ſlumbering floods,
Suſpended cataracts, and cryſtal woods,
Tranſparent towns, with ſeas of milk between,
And eyes with tranſport the refulgent ſcene:
If breaks the ſunſhine o'er the ſpangled trees,
Or flits on tepid wing the weſtern breeze,
In liquid dews deſcends the tranſient glare,
And all the glittering pageant melts in air.

Where Andes hides his cloud-wreath'd creſt in ſnow,
And roots his baſe on burning ſands below;
CINCHONA, faireſt of Peruvian maids,
To Health's bright Goddeſs in the breezy glades,
On Quito's temperate plain an altar rear'd,
Trill'd the loud hymn, the ſolemn prayer preferr'd:
Each balmy bud ſhe cull'd, and honey'd flower,
And hung with fragrant wreaths the ſacred bower;

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*Sevenfold reed.* l. 328. The ſevenfold reed, with which Pan is frequently deſcribed, ſeems to indicate, that he was the inventor of the muſical gamut.

*Cinchona.* l. 349. Peruvian bark-tree. Five males and one female. Several of theſe trees were felled for other purpoſes into a lake, when an epidemic fever of a very mortal kind prevailed at Loxa, in Peru, and the woodmen accidentally drinking the water, were cured; and thus were diſcovered the virtues of this famous drug.

Each pearly ſea ſhe ſearch'd, and ſparkling mine,
And piled their treaſures on the gorgeous ſhrine;
Her ſuppliant voice for ſickning Loxa raiſed,
Sweet breath'd the gale, and bright the cenſor blazed.
—" Divine HYGEIA! on thy votaries bend
" Thy angel-looks, oh, hear us, and defend!
" While ſtreaming o'er the night with baleful glare
" The ſtar of Autumn rays his miſty hair;
" Fierce from his fens the giant AGUE ſprings,
" And wrapp'd in fogs deſcends on vampire wings;
" Before, with ſhuddering limbs cold Tremor reels,
" And Fever's burning noſtril dogs his heels;
" Loud claps the grinning Fiend his iron hands,
" Stamps with black hoof, and ſhouts along the lands;
" Withers the damaſk cheek, unnerves the ſtrong,
" And drives with ſcorpion-laſh the ſhrieking throng.
" Oh, Goddeſs! on thy kneeling votaries bend
" Thy angel-looks, oh, hear us, and defend!"
—HYGEIA, leaning from the bleſt abodes,
The cryſtal manſions of the immortal gods,
Saw the ſad Nymph uplift her dewy eyes,
Spread her white arms, and breathe her fervid ſighs;
Call'd to her fair aſſociates, Youth and Joy,
And ſhot all radiant through the glittering ſky;
Looſe waved behind her golden train of hair,
Her ſapphire mantle ſwam diffuſed in air.—
O'er the grey matted moſs, and panſied ſod,
With ſtep ſublime the glowing Goddeſs trod,
Gilt with her beamy eye the conſcious ſhade,
And with her ſmile celeſtial bleſs'd the maid.
" Come to my arms," with ſeraph voice ſhe cries,
" Thy vows are heard, benignant Nymph! ariſe;
" Where yon aſpiring trunks fantaſtic wreath
" Their mingled roots, and drink the rill beneath,
" Yield to the biting axe thy ſacred wood,
" And ſtrew the bitter foliage on the flood."
In ſilent homage bow'd the bluſhing maid,—
*Five* youths athletic haſten to her aid,

O'er the ſcar'd hills re-echoing ſtrokes reſound,
And headlong foreſts thunder on the ground.
Round the dark roots, rent bark, and ſhatter'd boughs,
From ocherous beds the ſwelling fountain flows;
With ſtreams auſtere its widening margin laves,
And pours from vale to vale its duſky waves.
—As the pale ſquadrons, bending o'er the brink,
View with a ſigh their alter'd forms, and drink;
Slow-ebbing life with refluent crimſon breaks
O'er their wan lips, and paints their haggard cheeks;
Through each fine nerve rekindling tranſports dart,
Light the quick eye, and ſwell the exulting heart.
—Thus Israel's heaven-taught chief o'er trackleſs ſands
Led to the ſultry rock his murmuring bands.
Bright o'er his brows the forky radiance blazed,
And high in air the rod divine He raiſed.—
Wide yawns the cliff!—amid the thirſty throng
Ruſh the redundant waves, and ſhine along;
With gourds, and ſhells, and helmets, preſs the bands,
Ope their parch'd lips, and ſpread their eager hands,
Snatch their pale infants to the exuberant ſhower,
Kneel on the ſhatter'd rock, and bleſs the Almighty Power.

Bolſter'd with down, amid a thouſand wants,
Pale Dropſy rears his bloated form, and pants;
"Quench me, ye cool pellucid rills!" he cries,
Wets his parch'd tongue, and rolls his hollow eyes.
So bends tormented Tantalus to drink,
While from his lips the refluent waters ſhrink;
Again the riſing ſtream his boſom laves,
And thirſt conſumes him 'mid circumfluent waves.
—Divine Hygeia, from the bending ſky
Deſcending, liſtens to his piercing cry;
Aſſumes bright Digitalis' dreſs and air,
Her ruby cheek, white neck, and raven hair;

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*Digitalis.* l. 425. Of the claſs Two Powers. Four males, one female. Foxglove. The effect of this plant in that kind of Dropſy, which is termed anaſarca, where the legs and thighs are much ſwelled, attended with great

*Four* youths protect her from the circling throng,
And like the Nymph the Goddeſs ſteps along.—
—O'er Him She waves her ſerpent-wreathed wand,
Cheers with her voice, and raiſes with her hand, 430
Warms with rekindling bloom his viſage wan,
And charms the ſhapeleſs monſter into man.

So when Contagion, with mephitic breath,
And wither'd Famine, urged the work of death;
Marſeilles' good Biſhop, London's generous Mayor, 435
With food and faith, with medicine and with prayer,
Raiſed the weak head, and ſtayed the parting ſigh,
Or with new life relumed the ſwimming eye.—

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difficulty of breathing, is truly aſtoniſhing. In the aſcites, accompanied with anaſarca, of people paſt the meridian of life, it will alſo ſometimes ſucceed. The method of adminiſtering it requires ſome caution, as it is liable, in greater doſes, to induce very violent and debiliating ſickneſs, which continues one or two days, during which time the dropſical collection, however, diſappears. One large ſpoonful, or half an ounce, of the following decoction, given twice a day, will generally ſucceed in a few days. But in more robuſt people, one large ſpoonful every two hours, till four ſpoonfuls are taken, or till ſickneſs occurs, will evacuate the dropſical ſwellings with greater certainty, but is liable to operate more violently. Boil four ounces of the freſh leaves of purple Foxglove (which leaves may be had at all ſeaſons of the year) from two pints of water to twelve ounces; add to the ſtrained liquor, while yet warm, three ounces of rectified ſpirit of wine. A theory of the effects of this medicine, with many ſucceſsful caſes, may be ſeen in a pamphlet, called, "Experiments on Mucilaginous and Purulent Matter," publiſhed by Dr. Darwin in 1780. Sold by Cadell, London.

*Marſeilles' good Biſhop.* l. 435. In the year 1720 and 1722, the Plague made dreadful havock at Marſeilles; at which time the Biſhop was indefatigable in the execution of his paſtoral office, viſiting, relieving, encouraging, and abſolving the ſick with extreme tenderneſs; and though perpetually expoſed to the infection, like Sir John Lawrence, mentioned below, they both are ſaid to have eſcaped the diſeaſe.

*London's generous Mayor.* l. 435. During the great Plague at London in the year 1665, Sir John Lawrence, the then Lord Mayor, continued the whole time in the city; heard complaints, and redreſſed them; enforced the wiſeſt regulations then known, and ſaw them executed. The day after the diſeaſe was known with certainty to be the Plague, above 40,000 ſervants were diſmiſſed, and turned into the ſtreets to periſh, for no one would receive them into their houſes; and the villages near London drove them away with pitch-forks and fire-arms. Sir John Lawrence ſupported them all, as well as the needy who were ſick, at firſt by expending his own fortune, till ſubſcriptions could be ſolicited and received from all parts of the nation. *Journal of the Plague-year. Printed for E. Nutt, &c. at the Royal Exchange,* 1722.

—And now, PHILANTHROPY! thy rays divine
Dart round the globe from Zembla to the Line;
O'er each dark priſon plays the cheering light,
Like northern luſtres o'er the vault of night.—
From realm to realm, with croſs or creſcent crown'd,
Where'er Mankind and Miſery are found,
O'er burning ſands, deep waves, or wilds of ſnow,
Thy HOWARD, journeying, ſeeks the houſe of woe.
Down many a winding ſtep to dungeons dank,
Where anguiſh wails aloud, and fetters clank;
To caves beſtrew'd with many a mouldering bone,
And cells, whoſe echoes only learn to groan;
Where no kind bars a whiſpering friend diſcloſe,
No ſunbeam enters, and no zephyr blows,
HE treads, inemulous of fame or wealth,
Profuſe of toil and prodigal of health;
With ſoft aſſuaſive eloquence expands
Power's rigid heart, and opes his clenching hands;
Leads ſtern-ey'd Juſtice to the dark domains,
If not to ſever, to relax the chains;
Or guides awaken'd Mercy through the gloom,
And ſhews the priſon, ſiſter to the tomb!—
Gives to her babes the ſelf-devoted wife,
To her fond huſband liberty and life!
—The Spirits of the Good, who bend from high
Wide o'er theſe earthly ſcenes their partial eye,
When firſt, array'd in VIRTUE's pureſt robe,
They ſaw her HOWARD traverſing the globe;
Saw round his brows her ſun-like Glory blaze
In arrowy circles of unwearied rays;
Miſtook a Mortal for an Angel-Gueſt,
And aſk'd what Seraph-foot the earth impreſt.
—Onward he moves!—Diſeaſe and Death retire,
And murmuring Demons hate him, and admire."

Here pauſed the Goddeſs,—on HYGEIA's ſhrine
Obſequious Gnomes repoſe the lyre divine;

Deſcending Sylphs relax the trembling ſtrings, 475
And catch the rain-drops on their ſhadowy wings.
—And now her vaſe a modeſt Naiad fills
With liquid cryſtal from her pebbly rills;
Piles the dry cedar round her ſilver urn,
(Bright climbs the blaze, the crackling faggots burn), 480
Culls the green herb of China's envy'd bowers,
In gaudy cups the ſteamy treaſure pours;
And, ſweetly ſmiling, on her bended knee
Preſents the fragrant quinteſſence of Tea,

# INTERLUDE II.

*Bookseller.* THE monsters of your Botanic Garden are as surprising as the bulls with brazen feet, and the fire-breathing dragons, which guarded the Hesperian fruit; yet are they not disgusting, nor mischievous: and in the manner you have chained them together in your exhibition, they succeed each other amusingly enough, like prints of the London Cries, wrapped upon rollers, with a glass before them. In this, at least, they resemble the monsters in Ovid's Metamorphoses; but your similies, I suppose, are Homeric?

*Poet.* The great Bard well understood how to make use of this kind of ornament in Epic Poetry. He brings his valiant heroes into the field with much parade, and sets them a fighting with great fury; and then, after a few thrusts and parries, he introduces a long string of similies. During this the battle is supposed to continue; and thus the time necessary for the action is gained in our imaginations, and a degree of probability produced, which contributes to the temporary deception or reverie of the reader.

But the similies of Homer have another agreeable characteristic; they do not quadrate, or go upon all fours (as it is called), like the more formal similies of some modern writers; any one resembling feature seems to be, with him, a sufficient excuse for the introduction of this kind of digression. He then proceeds to deliver some agreeable poetry on this new subject, and thus converts every similie into a kind of short episode.

*B.* Then a similie should not very accurately resemble the subject?

*P.* No; it would then become a philosophical analogy; it would be ratiocination instead of poetry: it need only so far resemble the subject, as poetry itself ought to resemble nature. It should have so much sublimity, beauty, or novelty, as to interest the reader; and should be expressed in picturesque language, so as to bring the scenery before his eye; and should, lastly, bear so much veri-similitude as not to awaken him by the violence of improbability or incongruity.

*B*. May not the reverie of the reader be dissipated or disturbed by disagreeable images being presented to his imagination, as well as by improbable or incongruous ones?

*P*. Certainly; he will endeavour to rouse himself from a disagreeable reverie, as from the nightmare. And from this may be discovered the line of boundary between the Tragic and the Horrid; which line, however, will veer a little this way or that, according to the prevailing manners of the age or country, and the peculiar association of ideas, or idiosyncracy of mind, of individuals. For instance, if an artist should represent the death of an officer in battle, by shewing a little blood on the bosom of his shirt, as if a bullet had there penetrated, the dying figure would affect the beholder with pity; and if fortitude was at the same time expressed in his countenance, admiration would be added to our pity. On the contrary, if the artist should chuse to represent his thigh as shot away by a cannon ball, and should exhibit the bleeding flesh and shattered bone of the stump, the picture would introduce into our minds ideas from a butcher's shop, or a surgeon's operation room, and we should turn from it with disgust. So if characters were brought upon the stage with their limbs disjointed by torturing instruments, and the floor covered with clotted blood and scattered brains, our theatric reverie would be destroyed by disgust, and we should leave the play-house with detestation.

The Painters have been more guilty in this respect than the Poets. The cruelty of Apollo in flaying Marsyas alive is a favourite subject with the ancient artists: and the tortures of expiring martyrs have disgraced the modern ones. It requires little genius to exhibit the muscles in convulsive action, either by the pencil or the chissel, because the interstices are deep, and the lines strongly defined: but those tender gradations of muscular action, which constitute the graceful attitudes of the body, are difficult to conceive or to execute, except by a master of nice discernment and cultivated taste.

*B*. By what definition would you distinguish the Horrid from the Tragic?

*P*. I suppose the latter consists of Distress attended with Pity, which is said to be allied to Love, the most agreeable of all our passions; and the former, in Distress, accompanied with Disgust, which is allied to Hate, and is one of our most disagreeable sensations. Hence, when horrid scenes of cruelty are represented in pictures, we wish to disbelieve their existence, and voluntarily exert ourselves to escape from the deception: whereas the bitter cup of true Tragedy is mingled with some sweet consolatory drops, which endear our tears, and we continue to contemplate the interesting delusion with a delight which is not easy to explain.

*B.* Has not this been explained by Lucretius, where he describes a shipwreck, and says, the spectators receive pleasure from feeling themselves safe on land? and by Akenside, in his beautiful poem on the Pleasures of Imagination, who ascribes it to our finding objects for the due exertion of our passions?

*P.* We must not confound our sensations at the contemplation of real misery with those which we experience at the scenical representations of tragedy. The spectators of a shipwreck may be attracted by the dignity and novelty of the object; and from these may be said to receive pleasure; but not from the distress of the sufferers. An ingenious writer, who has criticised this dialogue in the English Review, for August, 1789, adds, that one great source of our pleasure from scenical distress, arises from our, at the same time, generally contemplating one of the noblest objects of nature, that of Virtue triumphant over every difficulty and oppression, or supporting its votary under every suffering: or, where this does not occur, that our minds are relieved by the justice of some signal punishment awaiting the delinquent. But, besides this, at the exhibition of a good tragedy, we are not only amused by the dignity, and novelty, and beauty, of the objects before us, but, if any distressful circumstances occur too forcibly for our sensibility, we can voluntarily exert ourselves, and recollect, that the scenery is not real; and thus not only the pain, which we had received from the apparent distress, is lessened, but a new source of pleasure is opened to us, similar to that which we frequently have felt on awaking from a distressful dream: we are glad that it is not true. We are, at the same time, unwilling to relinquish the pleasure which we receive from the other interesting circumstances of the drama; and, on that account, quickly permit ourselves to relapse into the delusion; and thus alternately believe and disbelieve, almost every moment, the existence of the objects represented before us.

*B.* Have those two sovereigns of poetic land, HOMER and SHAKESPEARE, kept their works entirely free from the Horrid?—or even yourself, in your third Canto?

*P.* The descriptions of the mangled carcases of the companions of Ulysses, in the cave of Polypheme, is, in this respect, certainly objectionable, as is well observed by Scaliger. And in the play of Titus Andronicus, if that was written by Shakespeare (which, from its internal evidence, I think very improbable), there are many horrid and disgustful circumstances. The following Canto is submitted to the candour of the critical reader, to whose opinion I shall submit in silence.

THE

# BOTANIC GARDEN.

## LOVES OF THE PLANTS.

### CANTO III.

AND now the Goddeſs ſounds her ſilver ſhell,
And ſhakes with deeper tones the inchanted dell;
Pale, round her graſſy throne, bedew'd with tears,
Flit the thin forms of Sorrows, and of Fears;
Soft Sighs, reſponſive, whiſper to the chords,
And Indignations half-unſheath their ſwords.

" Thrice round the grave CIRCÆA prints her tread,
And chaunts the numbers which diſturb the dead;

*Circæa.* l. 7. Enchanter's Nightſhade. Two males, one female. It was much celebrated in the myſteries of witchcraft, and for the purpoſe of raiſing the devil, as its name imports. It grows amid the mouldering bones and decayed coffins in the ruinous vaults of Sleaford-church, in Lincolnſhire. The ſuperſtitious ceremonies or hiſtories belonging to ſome vegetables have been truly ridiculous: Thus the Druids are ſaid to have cropped the Miſletoe with a golden axe or ſickle; and the Bryony, or Mandrake, was ſaid to utter a ſcream when its root was drawn from the ground; and that the animal which drew it up became diſeaſed, and ſoon died: on which account, when it was wanted for the purpoſe of medicine, it was uſual to looſen and remove the earth about the root, and then to tie it, by means of a cord, to a dog's tail, who was whipped to pull it up, and was then ſuppoſed to ſuffer for the impiety of the action. And even at this day bits of dried root of Peony are rubbed ſmooth, and ſtrung, and ſold under the name of Anodyne necklaces, and tied round the necks of children, to faciliate the growth of their teeth: add to this, that in Price's Hiſtory of Cornwall, a book publiſhed about ten years ago, the Virga Divinatoria, or Divining Rod, has a degree of credit given to it. This rod is of hazle, or other light wood, and held horizontally in the hand, and is ſaid to bow towards the ore whenever the Conjuror walks over a mine. A very few years ago, in France, and even in England, another kind of divining rod has been uſed to diſcover ſprings of water in a ſimilar manner, and gained ſome credit. And in this very year, there were many in France, and ſome in England,

Shakes o'er the holy earth her ſable plume,
Waves her dread wand, and ſtrikes the echoing tomb!
—Pale ſhoot the ſtars acroſs the troubled night,
The timorous moon withholds her conſcious light;
Shrill ſcream the famiſh'd bats, and ſhivering owls,
And loud and long the dog of midnight howls!—
—Then yawns the burſting ground!—*two* imps obſcene
Riſe on broad wings, and hail the baleful queen;
Each with dire grin ſalutes the potent wand,
And leads the Sorcereſs with his ſooty hand;
Onward they glide, where ſheds the ſickly yew,
O'er many a mouldering bone, its nightly dew;
The ponderous portals of the church unbar,—
Hoarſe on their hinge the ponderous portals jar;
As through the colour'd glaſs the moon-beam falls,
Huge ſhapeleſs ſpectres quiver on the walls;
Low murmurs creep along the hollow ground,
And to each ſtep the pealing ailes reſound;
By glimmering lamps, protecting ſaints among,
The ſhrines all trembling as they paſs along,
O'er the ſtill choir with hideous laugh they move,
(Fiends yell below, and angels weep above!)
Their impious march to God's high altar bend,
With feet impure the ſacred ſteps aſcend;
With wine unbleſs'd the holy chalice ſtain,
Aſſume the mitre, and the cope profane;
To heaven their eyes in mock devotion throw,
And to the croſs with horrid mummery bow;
Adjure by mimic rites the powers above,
And plight alternate their Satanic love.

Avaunt, ye Vulgar! from her ſacred groves,
With maniac ſtep the Pythian LAURA moves;

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who underwent an enchantment without any divining rod at all, and believed themſelves to be affected by an inviſible agent, which the Enchanter called Animal Magnetiſm!

*Laura.* l. 40. Prunus. Lauro-ceraſus. Twenty males, one female. The Pythian prieſteſs is ſuppoſed to have been made drunk with infuſion of laurel-leaves when ſhe delivered her oracles. The intoxication or inſpiration

Full of the God her labouring boſom ſighs,
Foam on her lips, and fury in her eyes,
Strong writhe her limbs, her wild diſhevell'd hair
Starts from her laurel-wreath, and ſwims in air.—
While *twenty* Prieſts the gorgeous ſhrine ſurround,
Cinctur'd with ephods, and with garlands crown'd,
Contending hoſts and trembling nations wait
The firm immutable beheſts of Fate;
—She ſpeaks in thunder from her golden throne,
With words *unwill'd*, and wiſdom not her own.

So on his NIGHTMARE, through the evening fog,
Flits the ſquab Fiend o'er fen, and lake, and bog;
Seeks ſome love-wilder'd Maid with ſleep oppreſs'd,
Alights, and, grinning, ſits upon her breaſt.
—Such as of late, amid the murky ſky,
Was mark'd by FUSELI's poetic eye;
Whoſe daring tints, with SHAKESPEARE's happieſt grace,
Gave to the airy phantom form and place.—
Back o'er her pillow ſinks her bluſhing head,
Her ſnow-white limbs hang helpleſs from the bed;
While with quick ſighs, and ſuffocative breath,
Her interrupted heart-pulſe ſwims in death.
—Then ſhrieks of captur'd towns, and widows' tears,
Pale lovers ſtretch'd upon their blood-ſtain'd biers,
The headlong precipice that thwarts her flight,
The trackleſs deſert, the cold ſtarleſs night,
And ſtern-ey'd Murderer, with his knife behind,
In dread ſucceſſion agonize her mind.

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is finely deſcribed by Virgil. Æn. lib. vi. The diſtilled water from laurel-leaves is, perhaps, the moſt ſudden poiſon we are acquianted with in this country. I have ſeen about two ſpoonfuls of it deſtroy a large pointer dog in leſs than ten minutes. In a ſmaller doſe it is ſaid to produce intoxication: on this account there is reaſon to believe it acts in the ſame manner as opium and vinous ſpirit; but that the doſe is not ſo well aſcertained. See note on Tremella. It is uſed in the Ratafie of the diſtillers, by which ſome dram-drinkers have been ſuddenly killed. One pint of water, diſtilled from fourteen pounds of black cherry ſtones bruiſed, has the ſame deleterious effect, deſtroying as ſuddenly as laurel-water. It is probable Apricot-kernels, Peach-leaves, Walnut-leaves, and whatever poſſeſſes the kernel-flavour, may have ſimilar qualities.

O'er her fair limbs convulſive tremors fleet,
Start in her hands, and ſtruggle in her feet;
In vain to ſcream with quivering lips ſhe tries,
And ſtrains in palſy'd lids her tremulous eyes;
In vain ſhe *wills* to run, fly, ſwim, walk, creep;
The WILL preſides not in the bower of SLEEP.
—On her fair boſom ſits the Demon-Ape
Erect, and balances his bloated ſhape;
Rolls in their marble orbs his Gorgon-eyes,
And drinks with leathern ears her tender cries.

Arm'd with her ivory beak, and talon-hands,
Deſcending FICA dives into the ſands;
Chamber'd in earth, with cold oblivion lies;
Nor heeds, *ye Suitor-train*, your amorous ſighs;

*The Will preſides not.* l. 74. Sleep conſiſts in the abolition of all voluntary power, both over our muſcular motions and our ideas; for we neither walk nor reaſon in ſleep. But, at the ſame time, many of our muſcular motions, and many of our ideas, continue to be excited into action in conſequence of internal irritations and of internal ſenſations; for the heart and arteries continue to beat, and we experience variety of paſſions, and even hunger and thirſt, in our dreams. Hence I conclude, that our nerves of ſenſe are not torpid or inert during ſleep; but that they are only precluded from the perception of external objects, by their external organs being rendered unfit to tranſmit to them the appulſes of external bodies, during the ſuſpenſion of the power of volition; thus the eye-lids are cloſed in ſleep, and, I ſuppoſe, the tympanum of the ear is not ſtretched, becauſe they are deprived of the voluntary exertions of the muſcles appropriated to theſe purpoſes; and it is probable ſomething ſimilar happens to the external apparatus of our other organs of ſenſe, which may render them unfit for their office of perception during ſleep; for milk put into the mouths of ſleeping babes occaſions them to ſwallow and ſuck; and, if the eye-lid is a little opened in the day-light by the exertions of diſturbed ſleep, the perſon dreams of being much dazzled. See firſt Interlude.

When there ariſes in ſleep a painful deſire to exert the voluntary motions, it is called the Nightmare, or Incubus. When the ſleep becomes ſo imperfect that ſome muſcular motions obey this exertion of deſire, people have walked about, and even performed ſome domeſtic offices in ſleep; one of theſe ſleep-walkers I have frequently ſeen; once ſhe ſmelt of a tube-roſe, and ſung, and drank a diſh of tea in this ſtate; her awaking was always attended with prodigious ſurprize, and even fear: this diſeaſe had daily periods, and ſeemed to be of the epileptic kind.

*Ficus indica.* l. 80. Indian Fig-tree. Of the claſs Polygamy. This large tree riſes with oppoſite branches on all ſides, with long egged leaves; each branch emits a ſlender flexile depending appendage from its ſummit, like a cord, which roots into the earth, and riſes again. Sloan. Hiſt. of Jamaica. Lin. Spec. Plant. See Capri-ficus.

Erewhile with renovated beauty blooms,
Mounts into air, and moves her leafy plumes.
—Where Hamps and Manifold, their cliffs among,
Each in his flinty channel winds along;
With lucid lines the duſky moor divides,
Hurrying to intermix their ſiſter tides:
Where ſtill their ſilver-boſom'd Nymphs abhor
The blood-ſmear'd manſion of gigantic Thor,—
—Erſt, fires volcanic in the marble womb
Of cloud-wrapp'd Wetton raiſed the maſſy dome;
Rocks rear'd on rocks in huge diſjointed piles
Form the tall turrets, and the lengthen'd ailes;
Broad ponderous piers ſuſtain the roof, and wide
Branch the vaſt rainbow ribs from ſide to ſide.
While from above deſcends, in milky ſtreams,
One ſcanty pencil of illuſive beams,
Suſpended crags and gaping gulphs illumes,
And gilds the horrors of the deepen'd glooms.

*Gigantic Thor.* l. 90. Near the village of Wetton, a mile or two above Dove-Dale, near Aſhburn, in Derbyſhire, there is a ſpacious cavern about the middle of the aſcent of the mountain, which ſtill retains the name of Thor's houſe; below it is an extenſive and romantic common, where the rivers Hamps and Manifold ſink into the earth, and riſe again in Ilam gardens, the ſeat of John Port, Eſq. about three miles below. Where theſe rivers riſe again, there are impreſſions reſemblimg Fiſh, which appear to be of Jaſper bedded in Lime-ſtone. Calcareous Spars, Shells converted into a kind of Agate, corallines in Marble, ores of Lead, Copper, and Zinc, and many ſtrata of Flint, or Chert, and of Toadſtone, or Lava, abound in this part of the country. The Druids are ſaid to have offered human ſacrifices incloſed in wicker idols to Thor. Thurſday had its name from this Deity.

The broken appearance of the ſurface of many parts of this country; with the Swallows, as they are called, or baſons on ſome of the mountains, like volcanic Craters, where the rain-water ſinks into the earth; and the numerous large ſtones, which ſeem to have been thrown over the land by volcanic exploſions; as well as the great maſſes of Toadſtone or Lava; evince the exiſtence of violent earthquakes at ſome early period of the world. At this time the channels of theſe ſubterraneous rivers ſeem to have been formed when a long tract of rocks were raiſed by the ſea flowing in upon the central fires, and thus producing an irreſiſtible exploſion of ſteam; and when theſe rocks again ſubſided, their parts did not exactly correſpond, but left a long cavity arched over in this operation of nature. The cavities at Caſtleton and Buxton, in Derbyſhire, ſeem to have had a ſimilar origin, as well as this cavern termed Thor's houſe. See Mr. Whitehurſt's and Dr. Hutton's Theories of the Earth.

—Here oft the Naiads, as they chanced to play
Near the dread Fane on Thor's returning day,
Saw from red altars ſtreams of guiltleſs blood
Stain their green reed-beds, and pollute their flood;
Heard dying babes in wicker priſons wail,
And ſhrieks of matrons thrill the affrighted Gale;
While from dark caves infernal Echoes mock,
And Fiends triumphant ſhout from every rock!
—*So* ſtill the Nymphs emerging lift in air
Their ſnow-white ſhoulders and their azure hair;
Sail with ſweet grace the dimpling ſtreams along,
Liſtening the Shepherd's or the Miner's ſong;
But, when afar they view the giant-cave,
On timorous fins they circle on the wave,
With ſtreaming eyes and throbbing hearts recoil,
Plunge their fair forms, and dive beneath the ſoil.—
Cloſed round their heads reluctant eddies ſink,
And wider rings ſucceſſive daſh the brink.—
Three thouſand ſteps in ſparry clefts they ſtray,
Or ſeek through ſullen mines their gloomy way;
On beds of Lava ſleep in coral cells,
Or ſigh o'er jaſper fiſh, and agate ſhells.
Till, where famed Ilam leads his boiling floods
Through flowery meadows and impending woods,
Pleaſed with light ſpring they leave the dreary night,
And 'mid circumfluent ſurges riſe to light;
Shake their bright locks, the widening vale purſue,
Their ſea-green mantles fringed with pearly dew;
In playful groups by towering Thorp they move,
Bound o'er the foaming wears, and ruſh into the Dove.

With fierce diſtracted eye Impatiens ſtands,
Swells her pale cheeks, and brandiſhes her hands,

*Impatiens.* l. 131. Touch me not. The ſeed-veſſel conſiſts of one cell with five diviſions; each of theſe, when the ſeed is ripe, on being touched ſuddenly folds itſelf into a ſpiral form, leaps from the ſtalk, and diſperſes the ſeeds to a great diſtance by its elaſticity. The capſule of the geranium and the beard of wild oats are twiſted for a ſimilar purpoſe, and diſlodge their ſeeds on wet days, when the ground is beſt fitted to receive them. Hence one of theſe, with its adhering capſule or beard fixed on a ſtand, ſerves the

With rage and hate the aſtoniſh'd groves alarms,
And hurls her infants from her frantic arms.
—So when **MEDÆA** left her native ſoil 135
Unaw'd by danger, unſubdued by toil;
Her weeping ſire and beckoning friends withſtood,
And launch'd enamour'd on the boiling flood;
One ruddy boy her gentle lips careſs'd,
And one fair girl was pillow'd on her breaſt; 140
While high in air the golden treaſure burns,
And Love and Glory guide the prow by turns.
But, when Theſſalia's inauſpicious plain
Received the matron-heroine from the main;
While horns of triumph ſound, and altars burn, 145
And ſhouting nations hail their Chief's return;
Aghaſt, She ſaw new-deck'd the nuptial bed,
And proud **CREUSA** to the temple led;
Saw her in **JASON**'s mercenary arms
Deride her virtues, and inſult her charms; 150
Saw her dear babes from fame and empire torn,
In foreign realms deſerted and forlorn;
Her love rejected, and her vengeance braved,
By Him her beauties won, her virtues ſaved.—
With ſtern regard ſhe eyed the traitor-king, 155
And felt, Ingratitude! thy keeneſt ſting;

purpoſe of an hygrometer, twiſting itſelf more or leſs according to the moiſture of the air.

The awn of barley is furniſhed with ſtiff points, which, like the teeth of a ſaw, are all turned towards the point of it; as this long awn lies upon the ground, it extends itſelf in the moiſt air of night, and puſhes forwards the barley corn, which it adheres to; in the day it ſhortens as it dries; and as theſe points prevent it from receding, it draws up its pointed end; and thus, creeping like a worm, will travel many feet from the parent ſtem. That very ingenious Mechanic Philoſopher, Mr. Edgworth, once made on this principle a wooden automaton; its back conſiſted of ſoft Fir-wood, about an inch ſquare and four feet long, made of pieces cut the croſs way in reſpect to the fibres of the wood, and glued together: it had two feet before, and two behind, which ſupported the back horizontally; but were placed with their extremities, which were armed with ſharp points of iron, bending backwards. Hence, in moiſt weather, the back lengthened, and the two foremoſt feet were puſhed forwards; in dry weather the hinder feet were drawn after, as the obliquity of the points of the feet prevented it from receding. And thus, in a month or two, it walked acroſs the room which it inhabited. Might not this machine be applied as an Hygrometer to ſome meteorological purpoſe?

" Not Heaven," ſhe cried, " nor Earth, nor Hell can hold
" A Heart abandon'd to the thirſt of Gold!"
Stamp'd with wild foot, and ſhook her horrent brow,
And call'd the furies from their dens below.
—Slow out of earth, before the feſtive crowds,
On wheels of fire, amid a night of clouds,
Drawn by fierce fiends, aroſe a magic car,
Received the Queen, and hovering flamed in air.—
As with raiſed hands the ſuppliant traitors kneel
And fear the vengeance they deſerve to feel,
Thrice with parch'd lips her guiltleſs babes ſhe preſs'd,
And thrice ſhe claſp'd them to her tortur'd breaſt;
Awhile with white uplifted eyes ſhe ſtood,
Then plung'd her trembling poniards in their blood.
" Go, kiſs your ſire! go, ſhare the bridal mirth!"
She cry'd, and hurl'd their quivering limbs on earth.
Rebellowing thunders rock the marble towers,
And red-tongued lightnings ſhoot their arrowy ſhowers;
Earth yawns!—the craſhing ruin ſinks!—o'er all
Death with black hands extends his mighty Pall;
Their mingling gore the Fiends of Vengeance quaff,
And Hell receives them with convulſive laugh.

Round the vex'd iſles where fierce tornadoes roar,
Or tropic breezes ſooth the ſultry ſhore;
What time the eve her gauze pellucid ſpreads
O'er the dim flowers, and veils the miſty meads;
Slow o'er the twilight ſands or leafy walks,
With gloomy dignity DICTAMNA ſtalks;

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*Dictamnus.* l. 184. Fraxinella. In the ſtill evenings of dry ſeaſons this plant emits an inflammable air or gas, and flaſhes on the approach of a candle. There are inſtances of human creatures who have taken fire ſpontaneouſly, and been totally conſumed. Phil. Tranſ.

The odours of many flowers, ſo delightful to our ſenſe of ſmell, as well as the diſagreeable ſcents of others, are owing to the exhalation of their eſſential oils. Theſe eſſential oils have greater or leſs volatility, and are all inflammable; many of them are poiſons to us, as thoſe of Laurel and Tobacco; others poſſeſs a narcotic quality, as is evinced by the oil of cloves inſtantly relieving ſlight tooth-achs [illegible] from oil of cinnamon relieving the hiccup; and balſam of peru relieving the pain of ſome ulcers. They are all deleterious to certain inſects, and hence their uſe in the vegetable economy being produced

In ſulphurous eddies round the weird dame
Plays the light gas, or kindles into flame.
If reſts the traveller his weary head,
Grim Mancinella haunts the moſſy bed,
Brews her black hebenon, and, ſtealing near,
Pours the curſt venom in his tortured ear.—
Wide o'er the mad'ning throng Urtica flings
Her barbed ſhafts, and darts her poiſon'd ſtings.

in flowers or leaves to protect them from the depredations of their voracious enemies. One of the eſſential oils, that of turpentine, is recommended by M. de Thoſſe, for the purpoſe of deſtroying inſects which infect both vegetables and animals. Having obſerved that the trees were attacked by multitudes of ſmall inſects of different colours (pucins ou pucerons), which injured their young branches, he deſtroyed them all entirely in the following manner: he put into a bowl a few handfuls of earth, on which he poured a ſmall quantity of oil of turpentine; he then beat the whole together with a ſpatula, pouring on it water till it became of the conſiſtence of ſoup: with this mixture he moiſtened the ends of the branches, and both the inſects and their eggs were deſtroyed, and other inſects kept aloof by the ſcent of the turpentine. He adds, that he deſtroyed the fleas of his puppies by once bathing them in warm water, impregnated with oil of turpentine. Mem. d'Agriculture, An. 1787. Tremeſt. Printemp. p. 109. I ſprinkled ſome oil of turpentine, by means of a bruſh, on ſome branches of a nectarine tree, which was covered with the aphis, but it killed both the inſect and the branches: a ſolution of arſenic much diluted did the ſame. The ſhops of medicine are ſupplied with reſins, balſams, and eſſential oils; and the tar and pitch, for mechanical purpoſes, are produced from theſe vegetable ſecretions.

*Mancinella.* l. 188. Hyppomane. With the milky juice of this tree the Indians poiſon their arrows; the dew-drops, which fall from it, are ſo cauſtic as to bliſter the ſkin, and produce dangerous ulcers; whence many have found their death by ſleeping under its ſhade. Variety of noxious plants abound in all countries; in our own, the deadly nightſhade, henbane, houndstongue, and many others, are ſeen in almoſt every high road, untouched by animals. Some have aſked, what is the uſe of ſuch abundance of poiſons? The nauſeous or pungent juices of ſome vegetables, like the thorns of others, are given them for their defence from the depredations of animals; hence the thorny plants are, in general, wholeſome and agreeable food to granivorous animals. See note on Ilex. The flowers or petals of plants are, perhaps, in general, more acrid than their leaves; hence they are much ſeldomer eaten by inſects. This ſeems to have been the uſe of the eſſential oil in the vegetable economy, as obſerved above, in the notes on Dictamnus and Ilex. The fragrance of plants is thus a part of their defence. Theſe pungent or nauſeous juices of vegetables have ſupplied the ſcience of medicine with its principal materials, ſuch as purge, vomit, intoxicate, &c.

*Urtica.* l. 191. Nettle. The ſting has a bag at its baſe, and a perforation near its point, exactly like the ſtings of waſps and the teeth of adders. Hook, Micrógr. p. 142. Is the fluid contained in this bag, and preſſed through the perforation into the wound made by the point, a cauſtic eſſen-

And fell LOBELIA's ſuffocating breath
Loads the dank pinion of the gale with death.
—With fear and hate they blaſt the affrighted groves, 195
Yet own with tender care their *kindred Loves!*—

  So, where PALMIRA 'mid her waſted plains,
Her ſhatter'd aqueducts, and proſtrate fanes,
(As the bright orb of breezy midnight pours
Long threads of ſilver through her gaping towers, 200
O'er mouldering tombs, and tottering columns gleams,
And froſts her deſerts with diffuſive beams),
Sad o'er the mighty wreck in ſilence bends,
Lifts her wet eyes, her tremulous hands extends.—
If from lone cliffs a burſting rill expands 205
Its tranſient courſe, and ſinks into the ſands;

tial oil, or a concentrated vegetable acid? The vegetable poiſons, like the animal ones, produce more ſudden and dangerous effects, when inſtilled into a wound, than when taken into the ſtomach; whence the families of Marſi and Pſilli, in ancient Rome, ſucked the poiſon, without injury, out of wounds made by vipers, and were ſuppoſed to be indued with ſupernatural powers for this purpoſe. By the experiments related by Beccaria, it appears, that four or five times the quantity, taken by the mouth, had about equal effects with that infuſed into a wound. The male flowers of the nettle are ſeparate from the female, and the anthers are ſeen, in fair weather, to burſt with force, and to diſcharge a duſt, which hovers about the plant like a cloud.

*Lobelia.* l. 193. Longiflora. Grows in the Weſt-Indies, and ſpreads ſuch deleterious exhalations around it, that an oppreſſion of the breaſt is felt on approaching it at many feet diſtance, when placed in the corner of a room or hot-houſe. Ingenhouz, Exper. on Air, p. 146. Jacquini hort. botanic. Vindeb. The exhalations from ripe fruit, or withering leaves, are proved much to injure the air in which they are confined; and, it is probable, all thoſe vegetables which emit a ſtrong ſcent may do this in a greater or leſs degree, from the Roſe to the Lobelia; whence the unwholeſomeneſs in living perpetually in ſuch an atmoſphere of perfume as ſome people wear about their hair, or carry in their handkerchiefs. Either Boerhaave or Dr. Mead have affirmed, they were acquainted with a poiſonous fluid whoſe vapour would preſently deſtroy the perſon who ſat near it. And it is well known, that the gas from fermenting liquors, or obtained from lime-ſtone, will deſtroy animals immerſed in it, as well as the vapour of the Grotto del Cani, near Naples.

*So, where Palmira.* l. 197. Among the ruins of Palmira, which are diſperſed not only over the plains, but even in the deſerts, there is one ſingle colonade above 2600 yards long, the baſes of the Corinthian columns of which exceed the height of a man: and yet this row is only a ſmall part of the remains of that one edifice. Volney's Travels.

O'er the moiſt rock the fell Hyæna prowls,
The Leopard hiſſes, and the Panther growls;
On quivering wing the famiſh'd Vulture ſcreams,
Dips his dry beak, and ſweeps the guſhing ſtreams;
With foaming jaws, beneath, and ſanguine tongue,
Laps the lean Wolf, and pants, and runs along;
Stern ſtalks the Lion, on the ruſtling brinks
Hears the dread Snake, and trembles as he drinks;
Quick darts the ſcaly Monſter o'er the plain,
Fold, after fold, his undulating train;
And bending o'er the lake his creſted brow,
Starts at the Crocodile that gapes below.

Where ſeas of glaſs with gay reflection ſmile
Round the green coaſt of Java's palmy iſle;
A ſpacious plain extends its upland ſcene,
Rocks riſe on rocks, and fountains guſh between;
Soft zephyrs blow, eternal ſummers reign,
And ſhowers prolific bleſs the ſoil,—in vain!
—No ſpicy nutmeg ſcents the vernal gales,
Nor towering plantain ſhades the mid-day vales;
No graſſy mantle hides the ſable hills,
No flowery chaplet crowns the trickling rills;
Nor tufted moſs, nor leathery lichen creeps
In ruſſet tapeſtry o'er the crumbling ſteeps.
—No ſtep retreating, on the ſand impreſs'd,
Invites the viſit of a ſecond gueſt;
No refluent fin the unpeopled ſtream divides,
No revolant pinion cleaves the airy tides;
Nor handed moles, nor beaked worms return,
That mining paſs the irremeable bourn.—
Fierce in dread ſilence on the blaſted heath
Fell UPAS ſits, the HYDRA-TREE of death.

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*Upas.* l. 238. There is a poiſon-tree in the iſland of Java, which is ſaid, by its effluvia, to have depopulated the country for 12 or 14 miles round the place of its growth. It is called, in the Malayan language, Bohon-Upas; with the juice of it the moſt poiſonous arrows are prepared; and, to gain this, the condemned criminals are ſent to the tree, with proper direction both to get the juice, and to ſecure themſelves from the malignant exhalations of the tree; and are pardoned if they bring back a certain quantity of

Lo! from one root, the envenom'd ſoil below,
A thouſand vegetative ſerpents grow;
In ſhining rays the ſcaly monſter ſpreads
O'er ten ſquare leagues his far-diverging heads;
Or in one trunk entwiſts his tangled form,
Looks o'er the clouds, and hiſſes in the ſtorm.
Steep'd in fell poiſon, as his ſharp teeth part,
A thouſand tongues in quick vibration dart;
Snatch the proud Eagle towering o'er the heath,
Or pounce the Lion, as he ſtalks beneath;
Or ſtrew, as marſhall'd hoſts contend in vain,
With human ſkeletons the whiten'd plain.
—Chain'd at his root two ſcion-demons dwell,
Breathe the faint hiſs, or try the ſhriller yell;
Riſe, fluttering in the air on callow wings,
And aim at inſect-prey their little ſtings.
So Time's ſtrong arms with ſweeping ſcythe eraſe
Art's cumberous works, and empires, from their baſe:
While each young Hour its ſickle fine employs,
And crops the ſweet buds of domeſtic joys!

With bluſhes bright as morn fair ORCHIS charms,
And lulls her infant in her fondling arms;

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the poiſon. But, by the regiſters there kept, not one in four are ſaid to return. Not only animals of all kinds, both quadrupeds, fiſh, and birds, but all kinds of vegetables alſo, are deſtroyed by the effluvia of the noxious tree; ſo that, in a diſtrict of 12 or 14 miles round it, the face of the earth is quite barren and rocky, intermixed only with the ſkeletons of men and animals, affording a ſcene of melancholy beyond what poets have deſcribed or painters delineated. Two younger trees of its own ſpecies are ſaid to grow near it. See London Magazine for 1784 or 1783. Tranſlated from a deſcription of the poiſon-tree of the iſland of Java, written in Dutch, by N. P. Foerſch. For a further account of it, ſee a note at the end of the work.

*Orchis.* l. 259. The Orchis morio in the circumſtance of the parent-root ſhrivelling up and dying, as the young one increaſes, is not only analogous to other tuberous or knobby roots, but alſo to ſome bulbous roots, as the tulip. The manner of the production of herbaceous plants from their various perennial roots, ſeems to want further inveſtigation, as their analogy is not yet clearly eſtabliſhed. The caudex, or true root, in the orchis, lies above the knob; and from this part the fibrous roots and the new knob are produced. In the tulip the caudex lies below the bulb; from whence proceed the fibrous roots and the new bulbs: the root, after it has flowered, dies like the orchis-root; for the ſtem of the laſt year's tulip lies on the outſide,

Soft plays *Affection* round her boſom's throne,
And guards his life, forgetful of her own.
So wings the wounded deer her headlong flight,
Pierced by ſome ambuſh'd archer of the night,
Shoots to the woodlands with her bounding fawn, 265
And drops of blood bedew the conſcious lawn;
There, hid in ſhades, ſhe ſhuns the cheerful day,
Hangs o'er her young, and weeps her life away.

So ſtood Eliza on the wood-crown'd height,
O'er Minden's plain, ſpectatreſs of the fight; 270
Sought with bold eye amid the bloody ſtrife
Her dearer ſelf, the partner of her life;
From hill to hill the ruſhing hoſt purſued,
And view'd his banner, or believed ſhe view'd.

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and not in the centre of the bulb; which, I am informed, does not happen in the three or four firſt years when raiſed from ſeed, when it only produces a ſtem, and ſlender leaves without flowering. In the tulip-root diſſected in the early ſpring, juſt before it begins to ſhoot, a perfect flower is ſeen in its centre; and between the firſt and ſecond coat the large next year's bulb is, I believe, produced; between the ſecond and third coat, and between this and the fourth coat, and perhaps further, other leſs and leſs bulbs are viſible, all adjoining to the caudex at the bottom of the mother bulb; and which, I am told, require as many years before they will flower as the number of the coats with which they are covered. This annual re-production of the tulip-root induces ſome floriſts to believe that tulip-roots never die naturally, as they loſe ſo few of them; whereas the hyacinth-roots, I am informed, will not laſt above five or ſeven years after they have flowered.

The hyacinth-root differs from the tulip-root, as the ſtem of the laſt year's flower is always found in the centre of the root, and the new offſets ariſe from the caudex below the bulb, but not beneath any of the concentric coats of the root, except the external one; hence Mr. Eaton, an ingenious floriſt of Derby, to whom I am indebted for moſt of the obſervations in this note, concludes, that the hyacinth-root does not periſh annually after it has flowered, like the tulip. Mr. Eaton gave me a tulip-root which had been ſet too deep in the earth, and the caudex had elongated itſelf near an inch, and the new bulb was formed above the old one, and detached from it, inſtead of adhering to its ſide. See addit. notes to Part I. No. XIV.

The caudex of the ranunculus, cultivated by the floriſts, lies above the claw-like root; in this the old root or claws die annually, like the tulip and orchis, and the new claws, which are ſeen above the old ones, draw down the caudex lower into the earth. The ſame is ſaid to happen to Scabioſa, or Devil's bit, and ſome other plants, as valerian and greater plantain; the new fibrous roots riſing round the caudex above the old ones, the inferior end of the root becomes ſtumped, as if cut off, after the old fibres are decayed, and the caudex is drawn down into the earth by theſe new roots. See Arum and Tulipa.

Pleaſed with the diſtant roar, with quicker tread
Faſt by his hand one liſping boy ſhe led;
And one fair girl amid the loud alarm
Slept on her kerchief, cradled by her arm;
While round her brows bright beams of Honour dart,
And Love's warm eddies circle round her heart.
—Near and more near the intrepid Beauty preſs'd,
Saw through the driving ſmoke his dancing creſt;
Saw on his helm, her virgin-hands inwove,
Bright ſtars of gold, and myſtic knots of love;
Heard the exulting ſhout, "they run! they run!"
"Great God!" ſhe cried, "He's ſafe! the battle's won!"
—A ball now hiſſes through the airy tides,
(Some Fury wing'd it, and ſome Demon guides!)
Parts the fine locks her graceful head that deck,
Wounds her fair ear, and ſinks into her neck;
The red ſtream, iſſuing from her azure veins,
Dyes her white veil, her ivory boſom ſtains.—
—"Ah me!" ſhe cried, and, ſinking on the ground,
Kiſs'd her dear babes, regardleſs of the wound;
"Oh, ceaſe not yet to beat, thou Vital Urn!
"Wait, guſhing Life, oh, wait my Love's return!—
"Hoarſe barks the wolf, the vulture ſcreams from far!—
"The angel, Pity, ſhuns the walks of war!—
"Oh, ſpare, ye War-hounds, ſpare their tender age!—
"On me, on me," ſhe cried, "exhauſt your rage!"—
Then with weak arms her weeping babes careſs'd,
And, ſighing, hid them in her blood-ſtain'd veſt.

From tent to tent the impatient warrior flies,
Fear in his heart, and frenzy in his eyes;
Eliza's name along the camp he calls,
Eliza echoes through the canvas walls;
Quick through the murmuring gloom his footſteps tread
O'er groaning heaps, the dying and the dead,
Vault o'er the plain, and in the tangled wood,
Lo! dead Eliza weltering in her blood!—

—Soon hears his liſtening ſon the welcome ſounds,
With open arms and ſparkling eyes he bounds:—
" Speak low," he cries, and gives his little hand,
" Eliza ſleeps upon the dew-cold ſand;
" Poor weeping babe with bloody fingers preſs'd, 315
" And tried with pouting lips her milkleſs breaſt;
" Alas! we both with cold and hunger quake—
" Why do you weep?—Mamma will ſoon awake."
—" She'll wake no more!" the hopeleſs mourner cried,
Upturn'd his eyes, and claſp'd his hands, and ſigh'd; 320
Stretch'd on the ground awhile entranc'd he lay,
And preſs'd warm kiſſes on the lifeleſs clay;
And then upſprung with wild convulſive ſtart,
And all the Father kindled in his heart; 324
" Oh, Heavens," he cried, " my firſt raſh vow forgive!
" Theſe bind to earth, for theſe I pray to live!"—
Round his chill babes he wrapp'd his crimſon veſt,
And claſp'd them ſobbing to his aching breaſt.

*Two* Harlot-Nymphs, the fair CUSCUTAS, pleaſe
With labour'd negligence, and ſtudied eaſe; 330

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*Cuſcuta.* l. 329. Dodder. Four males, two females. This paraſite plant (the ſeed ſplitting without cotyledons) protrudes a ſpiral body, and not endeavouring to root itſelf in the earth, aſcends the vegetables in its vicinity, ſpirally W. S. E. or contrary to the movement of the ſun; and abſorbs its nouriſhment by veſſels apparently inſerted into its ſupporters. It bears no leaves, except here and there a ſcale, very ſmall, membranous, and cloſe under the branch. Lin. Spec. Plant. edit. a Reichard, vol. i. p. 352. The Rev. T. Martyn, in his elegant letters on botany, adds, that, not content with ſupport, where it lays hold, there it draws its nouriſhment; and at length, in gratitude for all this, ſtrangles its entertainer. Let. xv. A conteſt for air and light obtains throughout the whole vegetable world; ſhrubs riſe above herbs; and, by precluding the air and light from them, injure or deſtroy them; trees ſuffocate or incommode ſhrubs; the paraſite climbing plants, as Ivy, Clematis, incommode the taller trees; and other paraſites, which exiſt without having roots on the ground, as Miſletoe, Tillandſia, Epidendrum, and the moſſes and funguſes, incommode them all.

Some of the plants with voluble ſtems aſcend other plants ſpirally eaſt-ſouth-weſt, as Humulus, Hop, Lonicera, Honey-ſuckle, Tamus, black Bryony, Helxine. Others turn their ſpiral ſtems weſt-ſouth-eaſt, as Convolvulus, Corn-bind, Phaſeolus, Kidney-bean, Baſella, Cynanche, Euphorbia, Eupatorium. The proximate or final cauſes of this difference have not been inveſtigated. Other plants are furniſhed with tendrils for the purpoſe of

In the meek garb of modeſt worth diſguiſed,
The eye averted, and the ſmile chaſtiſed,
With ſly approach they ſpread their dangerous charms,
And round their victim wind their wiry arms.
So by Scamander when LAOCOON ſtood, 335
Where Troy's proud turrets glitter'd in the flood
Raiſed high his arm, and with prophetic call,
To ſhrinking realms announced her fated fall;
Whirl'd his fierce ſpear with more than mortal force,
And pierced the thick ribs of the echoing horſe; 340
Two Serpent-forms incumbent on the main,
Laſhing the white waves with redundant train,
Arch'd their blue necks, and ſhook their towering creſts,
And plough'd their foamy way with ſpeckled breaſts;
Then, darting fierce amid the affrighted throngs, 345
Roll'd their red eyes, and ſhot their forked tongues.—
—Two daring youths to guard the hoary ſire,
Thwart their dread progreſs, and provoke their ire.
Round ſire and ſons the ſcaly monſters roll'd,
Ring above ring, in many a tangled fold, 350
Cloſe and more cloſe their writhing limbs ſurround,
And fix with foamy teeth the envenom'd wound.
—With brow upturn'd to heaven, the holy Sage
In ſilent agony ſuſtains their rage;
While each fond youth, in vain, with piercing cries, 355
Bends on the tortured Sire his dying eyes.

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climbing; if the tendril meets with nothing to lay hold of in its firſt revolution, it makes another revolution; and ſo on till it wraps itſelf quite up like a cork-ſcrew; hence, to a careleſs obſerver, it appears to move gradually backwards and forwards, being ſeen ſometimes pointing eaſtward and ſometimes weſtward. One of the Indian graſſes, Panicum arboreſcens, whoſe ſtem is no thicker than a gooſe-quill, riſes as high as the talleſt trees in this conteſt for light and air. Spec. Plant. a Reichard, vol. i. p. 161. The tops of many climbing plants are tender from their quick growth; and, when deprived of their acrimony by boiling, are an agreeable article of food. The Hop-tops are in common uſe. I have eaten the tops of white Bryony, Bryonia alba, and found them nearly as grateful as Aſparagus, and think this plant might be profitably cultivated as an early garden-vegetable. The Tamus (called black Bryony) was leſs agreeable to the taſte when boiled. See Galanthus.

“ Drink deep, ſweet youths,” ſeductive VITIS cries,
The maudlin tear-drop glittering in her eyes;
Green leaves and purple cluſters crown her head,
And the tall Thyrſus ſtays her tottering tread.
—*Five* hapleſs ſwains, with ſoft aſſuaſive ſmiles,
The harlot meſhes in her deathful toils;
“ Drink deep,” ſhe carols, as ſhe waves in air
The mantling goblet, “ and forget your care.”—
O'er the dread feaſt malignant Chemia ſcowls,
And mingles poiſon in the nectar'd bowls;
Fell Gout peeps, grinning, through the flimſy ſcene,
And bloated Dropſy pants behind unſeen;
Wrapp'd in his robe white Lepra hides his ſtains,
And ſilent Frenzy, writhing, bites his chains.

So when PROMETHEUS brav'd the Thunderer's ire,
Stole from his blazing throne ethereal fire,
And, lantern'd in his breaſt, from realms of day
Bore the bright treaſure to his Man of clay;—

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*Vitis.* l. 357. Vine. Five males, one female. The juice of the ripe grape is a nutritive and agreeable food, conſiſting chiefly of ſugar and mucilage. The chemical proceſs of fermentation converts this ſugar into ſpirit; converts food into poiſon! And it has thus become the curſe of the Chriſtian world, producing more than half of our chronical diſeaſes; which Mahomet obſerved, and forbade the uſe of it to his diſciples. The Arabians invented diſtillation; and thus, by obtaining the ſpirit of fermented liquors in a leſs diluted ſtate, added to its deſtructive quality. A theory of the Diabetes and Dropſy, produced by drinking fermented or ſpirituous liquors, is explained in a Treatiſe on the inverted Motions of the Lymphatic Syſtem, publiſhed by Dr. Darwin. Cadel.

*Prometheus.* l. 371. The ancient ſtory of Prometheus, who concealed in his boſom the fire he had ſtolen, and afterwards had a vulture perpetually gnawing his liver, affords ſo apt an allegory for the effects of drinking ſpirituous liquors, that one ſhould be induced to think the art of diſtillation, as well as ſome other chemical proceſſes (ſuch as calcining gold), had been known in times of great antiquity, and loſt again. The ſwallowing drams cannot be better repreſented in hieroglyphic language than by taking fire into one's boſom; and certain it is, that the general effect of drinking fermented or ſpirituous liquors, is an inflamed ſchirrous, or paralytic liver, with its various critical or conſequential diſeaſes, as leprous eruptions on the face, gout, dropſy, epilepſy, inſanity. It is remarkable, that all the diſeaſes from drinking ſpirituous or fermented liquors are liable to become hereditary, even to the third generation, gradually increaſing, if the cauſe be continued, till the family becomes extinct.

High on cold Caucaſus by **VULCAN** bound,
The lean impatient Vulture fluttering round,
His writhing limbs in vain he twiſts and ſtrains
To break or looſe the adamantine chains.
The gluttonous bird, exulting in his pangs,
Tears his ſwoln liver with remorſeleſs fangs.

The gentle **CYCLAMEN**, with dewy eye,
Breathes o'er her lifeleſs babe the parting ſigh;
And, bending low to earth, with pious hands
Inhumes her dear departed in the ſands.
" Sweet Nurſling! withering in thy tender hour,
" Oh, ſleep," ſhe cries, " and riſe a fairer flower!"[x]
—So when the Plague o'er London's gaſping crowds
Shook her dank wing, and ſteer'd her murky clouds;
When o'er the friendleſs bier no rites were read,
No dirge ſlow-chaunted, and no pall out-ſpread;
While Death and Night piled up the naked throng,
And Silence drove their ebon cars along;
Six lovely daughters, and their father, ſwept
To the throng'd grave **CLEONE** ſaw, and wept;
Her tender mind, with meek Religion fraught,
Drank, all-reſigned, Affliction's bitter draught;
Alive, and liſtening to the whiſper'd groan
Of others' woes, unconſcious of her own!—
One ſmiling boy, her laſt ſweet hope, ſhe warms,
Huſh'd on her boſom, circled in her arms.—

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*Cyclamen.* l. 381. Shew-bread, or Show-bread. When the ſeeds are ripe, the ſtalk of the flower gradually twiſts itſelf ſpirally downwards, till it touches the ground, and, forcibly penetrating the earth, lodges its ſeeds, which are thought to receive nouriſhment from the parent root, as they are ſaid not to be made to grow in any other ſituation.

The Trifolium ſubterraneum, ſubterraneous trefoil, is another plant which buries its ſeeds, the globular head of the ſeed penetrating the earth; which, however, in this plant, may be only an attempt to conceal its ſeeds from the ravages of birds; for there is another trefoil, the Trifolium Globoſum, or globular wooly-headed trefoil, which has a curious manner of concealing its ſeeds; the lower florets only have corols, and are fertile; the upper ones wither into a kind of wool, and, forming a head, completely conceal the fertile calyxes. Lin. Spec. Plant. a Reichard.

Daughter of woe! ere morn, in vain careſs'd,
Clung the cold babe upon thy milkleſs breaſt,
With feeble cries thy laſt ſad aid required,
Stretch'd its ſtiff limbs, and on thy lap expired!—
—Long, with wide eye-lids, on her child ſhe gazed,
And long to Heaven their tearleſs orbs ſhe raiſed;
Then with quick foot and throbbing heart ſhe found
Where Chartreuſe open'd deep his holy ground;
Bore her laſt treaſure through the midnight gloom,
And, kneeling, dropp'd it in the mighty tomb;
" I follow next!" the frantic mourner ſaid,
And, living, plunged amid the feſtering dead.

Where vaſt Ontario rolls his brineleſs tides,
And feeds the trackleſs foreſts on his ſides,
Fair CASSIA, trembling, hears the howling woods,
And truſts her tawny children to the floods.—

*Where Chartreuſe.* l. 408. During the plague in London, 1665, one pit to receive the dead was dug in the Charter-houſe, 40 feet long, 16 feet wide, and about 20 feet deep; and in two weeks received 1114 bodies. During this dreadful calamity there were inſtances of mothers carrying their own children to thoſe public graves, and of people delirious, or in deſpair from the loſs of their friends, who threw themſelves alive into theſe pits. Journal of the Plague-year in 1665, printed for E. Nutt, Royal Exchange.

*Rolls his brineleſs tides.* l. 413. Some philoſophers have believed that the continent of America was not raiſed out of the great ocean at ſo early a period of time as the other continents. One reaſon for this opinion was, becauſe the great lakes, perhaps nearly as large as the Mediterranean Sea, conſiſt of freſh water. And, as the ſea-ſalt ſeems to have its origin from the deſtruction of vegetable and animal bodies, waſhed down by rains, and carried by rivers into lakes or ſeas, it would ſeem that this ſource of ſea-ſalt had not ſo long exiſted in that country. There is, however, a more ſatisfactory way of explaining this circumſtance; which is, that the American lakes lie above the level of the ocean, and are hence perpetually deſalited by the rivers which run through them; which is not the caſe with the Mediterranean, into which a current from the main ocean perpetually paſſes.

*Caſſia.* l. 415. Ten males, one female. The ſeeds are black, the ſtamens gold-colour. This is one of the American fruits which are annually thrown on the coaſts of Norway; and are frequently in ſo recent a ſtate as to vegetate, when properly taken care of. The fruit of the anacardium, caſhew-nut; of cucurbita lagenaria, bottle-gourd; of the mimoſa ſcandens, cocoons; of the piſcidia erythrina, logwood-tree; and cocoa-nuts, are enumerated by Dr. Tonning (Amœn. Acad. 149), amongſt theſe emigrant ſeeds. The fact is truly wonderful, and cannot be accounted for but by the exiſtence of under currents in the depths of the ocean; or from vortexes of water paſſing from one country to another through caverns of the earth.

Cinctured with gold, while *ten* fond brothers ſtand,
And guard the beauty on her native land;
Soft breathes the gale, the current gently moves,
And bears to Norway's coaſts her infant-loves. 420

Sir Hans Sloane has given an account of four kinds of ſeeds, which are frequently thrown by the ſea upon the coaſts of the iſlands of the northern parts of Scotland. Phil. Tranſ. abridged, vol. iii. p. 540. Which ſeeds are natives of the Weſt-Indies, and ſeem to be brought thither by the Gulph-ſtream deſcribed below. One of theſe is called, by Sir H. Sloane, Phaſeolus maximus perennis, which is often thrown alſo on the coaſt of Kerry, in Ireland; another is called, in Jamaica, Horſe-eye-bean; and a third is called Niker, in Jamaica. He adds, that the Lenticula marina, or Sargoſſo, grows on the rocks about Jamaica, is carried by the winds and current towards the coaſts of Florida, and thence into the North-American ocean, where it lies very thick on the ſurface of the ſea.

Thus a rapid current paſſes from the Gulph of Florida to the N. E. along the coaſt of North-America, known to ſeamen by the name of the GULPH-STREAM. A chart of this was publiſhed by Dr. Franklin in 1768, from the information principally of Capt. Folger. This was confirmed by the ingenious experiments of Dr. Blagden, publiſhed in 1781; who found that the water of the Gulph-ſtream was from ſix to eleven degrees warmer than the water of the ſea through which it ran; which muſt have been occaſioned by its being brought from a hotter climate. He aſcribes the origin of this current to the power of the trade-winds, which, blowing always in the ſame direction, carry the waters of the Atlantic ocean to the weſtward, till they are ſtopped by the oppoſing continent on the weſt of the Gulph of Mexico, and are thus accumulated there, and run down the Gulph of Florida. Phil. Tranſ. vol. lxxi. p. 335. Governor Pownal has given an elegant map of this Gulph-ſtream, tracing it from the Gulph of Florida, northward, as far as Cape-Sable, in Nova-Scotia, and then acroſs the Atlantic ocean to the coaſt of Africa, between the Canary Iſlands and Senegal, increaſing in breadth, as it runs, till it occupies five or ſix degrees of latitude. The Governor likewiſe aſcribes this current to the force of the trade-winds *protruding* the waters weſtward, till they are oppoſed by the continent, and accumulated in the Gulph of Mexico. He very ingeniouſly obſerves, that a great eddy muſt be produced in the Atlantic ocean, between this Gulph-ſtream and the weſterly current protruded by the tropical winds; and in this eddy are found the immenſe fields of floating vegetables, called Saragoſa weeds, and Gulph weeds, and ſome light woods, which circulate in theſe vaſt eddies, or are occaſionally driven out of them by the winds. Hydraulic and Nautical Obſervations, by Governor Pownal, 1787. Other currents are mentioned by the Governor in this ingenious work, as thoſe in the Indian Sea, northward of the line, which are aſcribed to the influence of the Monſoons. It is probable that, in proceſs of time, the narrow tract of land on the weſt of the Gulph of Mexico, may be worn away by this elevation of water daſhing againſt it, by which this immenſe current would ceaſe to exiſt, and a wonderful change take place in the Gulph of Mexico and Weſt-Indian iſlands, by the ſubſiding of the ſea, which might probably lay all thoſe iſlands into one, or join them to the continent.

—So the ſad mother, at the moon of night,
From bloody Memphis ſtole her ſilent flight;
Wrapp'd her dear babe beneath her folded veſt,
And claſp'd the treaſure to her throbbing breaſt,
With ſoothing whiſpers huſh'd its feeble cry,
Preſs'd the ſoft kiſs, and breath'd the ſecret ſigh.—
—With dauntleſs ſtep ſhe ſeeks the winding ſhore,
Hears unappall'd the glimmering torrents roar;
With Paper-flags a floating cradle weaves,
And hides the ſmiling boy in Lotus-leaves;
Gives her white boſom to his eager lips,
The ſalt-tears mingling with the milk he ſips;
Waits on the reed-crown'd brink with pious guile,
And truſts the ſcaly monſters of the Nile.——
—Erewhile majeſtic from his lone abode,
Embaſſador of Heaven, the Prophet trod;
Wrench'd the red ſcourge from proud Oppreſſion's hands,
And broke, curſt Slavery! thy iron bands.

Hark! heard ye not that piercing cry,
Which ſhook the waves and rent the ſky?—

E'en now, e'en now, on yonder Weſtern ſhores
Weeps pale Deſpair, and writhing Anguiſh roars:
E'en now in Afric's groves with hideous yell
Fierce SLAVERY ſtalks, and ſlips the dogs of hell;
From vale to vale the gathering cries rebound,
And ſable nations tremble at the ſound!——
—YE BANDS OF SENATORS! whoſe ſuffrage ſways
Britannia's realms, whom either Ind obeys;
Who right the injured, and reward the brave,
Stretch your ſtrong arm, for ye have power to ſave!
Throned in the vaulted heart, his dread reſort,
Inexorable CONSCIENCE holds his court;
With ſtill ſmall voice the plots of Guilt alarms,
Bares his maſk'd brow, his lifted hand diſarms;
But, wrapp'd in night with terrors all his own,
He ſpeaks in thunder, when the deed is done.

*Hear him*, ye Senates! hear this truth ſublime,
"*He, who allows Oppreſſion, ſhares the crime.*"

No radiant pearl, which creſted Fortune wears,
No gem, that twinkling hangs from Beauty's ears,
Not the bright ſtars, which Night's blue arch adorn,
Nor riſing ſuns that gild the vernal morn,
Shine with ſuch luſtre as the tear that flows
Down Virtue's manly cheek for others' woes."

Here ceaſed the MUSE, and dropp'd her tuneful ſhell,
Tumultuous woes her panting boſom ſwell;
O'er her fluſh'd cheek her gauzy veil ſhe throws,
Folds her white arms, and bends her laurel'd brows;
For human guilt awhile the Goddeſs ſighs,
And human ſorrows dim celeſtial eyes.

# INTERLUDE III.

*Bookseller.* POETRY has been called a sister-art both to Painting and to Music: I wish to know what are the particulars of their relationship?

*Poet.* It has been already observed, that the principal part of the language of poetry consists of those words, which are expressive of the ideas, which we originally receive by the organ of sight; and, in this, it nearly, indeed, resembles painting; which can express itself in no other way, but by exciting the ideas or sensations belonging to the sense of vision. But besides this essential similitude in the language of the poetic pen and pencil, these two sisters resemble each other, if I may so say, in many of their habits and manners. The painter, to produce a strong effect, makes a few parts of his picture large, distinct, and luminous, and keeps the remainder in shadow, or even beneath its natural size and colour, to give eminence to the principal figure. This is similar to the common manner of poetic composition, where the subordinate characters are kept down, to elevate and give consequence to the hero or heroine of the piece.

In the south aile of the cathedral church at Lichfield, there is an ancient monument of a recumbent figure; the head and neck of which lie on a roll of matting, in a kind of niche or cavern in the wall; and about five feet distant horizontally, in another opening or cavern in the wall, are seen the feet and ankles, with some folds of garment, lying also on a matt; and though the intermediate space is a solid stone-wall, yet the imagination supplies the deficiency, and the whole figure seems to exist before our eyes. Does not this resemble one of the arts both of the painter and the poet? The former often shews a muscular arm amidst a group of figures, or an impassioned face; and, hiding the remainder of the body behind other objects, leaves the imagination to complete it. The latter, describing a single feature or attitude in picturesque words, produces before the mind an image of the whole.

I remember seeing a print, in which was represented a shrivelled hand, stretched through an iron grate, in the stone floor of a prison-yard, to reach at a mess of porrage, which affected me with more horrid ideas of the distress of the prisoner in the dungeon below, than could have been, perhaps, produced by an exhibition of the whole person. And, in the following beautiful scenery from the Midsummer-night's Dream, (in which I have taken the liberty to alter the place of a comma,) the description of the swimming step and prominent belly bring the whole figure before our eyes with the distinctness of reality.

When we have laugh'd to see the sails conceive,
And grow big-bellied with the wanton wind;
Which she with pretty and with swimming gate,
Following her womb, (then rich with my young squire,)
Would imitate, and sail upon the land.

There is a third sister-feature, which belongs both to the pictorial and poetic art; and that is, the making sentiments and passions visible, as it were, to the spectator: this is done in both arts by describing or pourtraying the effects or changes which those sentiments or passions produce upon the body. At the end of the unaltered play of Lear, there is a beautiful example of poetic painting: the old King is introduced as dying from grief for the loss of Cordelia: at this crisis, Shakespeare, conceiving the robe of the King to be held together by a clasp, represents him as only saying to an attendant courtier, in a faint voice, "Pray, Sir, undo this button,—thank you, Sir," and dies. Thus, by the art of the poet, the oppression at the bosom of the dying King is made visible, not described in words.

*B.* What are the features in which these sister-arts do not resemble each other?

*P.* The ingenious Bishop Berkeley, in his Treatise on Vision, a work of great ability, has evinced, that the colours which we see, are only a language suggesting to our minds the ideas of solidity and extension, which we had before received by the sense of touch. Thus, when we view the trunk of a tree, our eye can only acquaint us with the colours or shades; and from the previous experience of the sense of touch, these suggest to us the cylindrical form, with the prominent or depressed wrinkles on it. From hence it appears, that there is the strictest analogy between colours and sounds; as they are both but languages, which do not represent their correspondent ideas, but only suggest them to the mind, from the habits or associations of previous experience. It is, therefore, reasonable to conclude, that the more artificial arrangements of these two languages, by the poet and the painter, bear a similar analogy.

But, in one circumstance, the pen and the pencil differ widely from each other; and that is, the quantity of time which they can include in their respective representations. The former can unravel a long series of events, which may constitute the history of days or years; while the latter can exhibit only the actions of a moment. The poet is happier in describing successive scenes; the painter in representing stationary ones: both have their advantages.

Where the passions are introduced, as the poet, on one hand, has the power gradually to prepare the mind of his reader by previous climacteric circumstances, the painter, on the other hand, can throw stronger illumination and distinctness on the principal moment or catastrophe of the action; besides the advantage he has in using an universal language, which can be *read* in an instant of time. Thus, where a great number of figures are all seen together, supporting or contrasting each other, and contributing to explain or aggrandize the principal effect, we view a picture with agreeable surprize, and contemplate it with unceasing admiration. In the representation of the sacrifice of Jephtha's daughter, a print done from a painting of Ant. Coypel, at one glance of the eye we read all the interesting passages of the last act of a well-written tragedy; so much poetry is there condensed into a moment of time.

*B.* Will you now oblige me with an account of the relationship between Poetry, and her other sister, Music?

*P.* In the poetry of our language I don't think we are to look for any thing analogous to the notes of the gamut: for, except, perhaps, in a few exclamations or interrogations, we are at liberty to raise or sink our voice an octave or two at pleasure, without altering the sense of the words. Hence, if either poetry or prose be read in melodious tones of voice, as is done in recitativo, or in chaunting, it must depend on the speaker, not on the writer: for though words may be selected which are less harsh than others, that is, which have fewer sudden stops, or abrupt consonants amongst the vowels, or with fewer sibilant letters, yet this does not constitute melody, which consists of agreeable successions of notes referable to the gamut; or harmony, which consists of agreeable combinations of them. If the Chinese language has many words of similar articulation, which yet signify different ideas, when spoken in a higher or lower musical note, as some travellers affirm, it must be capable of much finer effect, in respect to the audible part of poetry, than any language we are acquainted with.

There is, however, another affinity in which poetry and music more nearly resemble each other than has generally been understood, and that is in their measure or time. There are but two kinds of time acknowledged in modern music, which are called *triple time* and *common time*. The former of these is divided by bars, each bar containing three crotchets, or a proportional number of their subdivisions into quavers and semiquavers. This kind of time is analogous to the measure of our heroic or iambic verse. Thus the two following couplets are each of them divided into five bars of *triple time*, each bar consisting of two crotchets and two quavers; nor can they be divided into bars analogous to *common time*, without the bars interfering with some of the crotchets, so as to divide them.

3 Soft warbling beaks | in each bright blos | som move,
4 And vo | cal rosebuds thrill | the inchanted grove. |

In these lines there is a quaver and a crotchet alternately in every bar, except in the last, in which *the in* make two semiquavers; the *e* is supposed, by Grammarians, to be cut off, which any one's ear will readily determine not to be true.

3 Life buds or breathes | from Indus to | the poles,
4 And the | vast surface kind | les, as it rolls. |

In these lines there is a quaver and a crotchet alternately in the first bar; a quaver, two crotchets, and a quaver, make the second bar. In the third bar there is a quaver, a crotchet, and a rest after the crotchet, that is, after the word *poles*, and two quavers begin the next line. The fourth bar consists of quavers and crotchets alternately. In the last bar there is a quaver, and a rest after it, viz. after the word *kindles;* and then two quavers and a crotchet. You will clearly perceive the truth of this, if you prick the musical characters above-mentioned under the verses.

The *common time* of musicians is divided into bars, each of which contains four crotchets, or a proportional number of their subdivision into quavers and semiquavers. This kind of musical time is analogous to the dactyle verses of our language, the most popular instances of which are in Mr. Anstie's Bath-Guide. In this kind of verse the bar does not begin till after the first or second syllable; and where the verse is quite complete, and written by a good ear, these first syllables, added to the last, complete the bar, exactly, in this also, corresponding with many pieces of music:

2 Yet | if one may guess by the | size of his calf, Sir,
4 He | weighs above twenty-three | stone and a half, Sir.

2 Master | Mamozet's head was not | finished so soon,
4 For it | took up the barber a | whole afternoon.

In these lines each bar consists of a crotchet, two quavers, another crotchet, and two more quavers; which are equal to four crotchets, and, like many bars of *common time* in music, may be subdivided into two, in beating time without disturbing the measure.

The following verses from Shenstone belong likewise to common time:

2 A | river or a sea |
4 Was to him a dish | of tea,
And a king | dom bread and butter.

The first and second bars consist each of a crotchet, a quaver, a crotchet, a quaver, a crotchet. The third bar consists of a quaver, two crotchets, a quaver, a crotchet. The last bar is not complete without adding the letter A, which begins the first line, and then it consists of a quaver, a crotchet, a quaver, a crotchet, two quavers.

It must be observed, that the crotchets in triple time are, in general, played by musicians slower than those of common time, and hence minuets are generally pricked in triple time, and country dances generally in common time. So the verses above related, which are analogous to *triple time*, are generally read slower than those analogous to *common time;* and are thence generally used for graver compositions. I suppose all the different kinds of verses to be found in our odes, which have any measure at all, might be arranged under one or other of these two musical times; allowing a note or two sometimes to precede the commencement of the bar, and occasional rests, as in musical compositions: if this was attended to by those who set poetry to music, it is probable the sound and sense would oftener coincide. Whether these musical times can be applied to the lyric and heroic verses of the Greek and Latin poets, I do not pretend to determine; certain it is, that the dactyle verse of our language, when it is ended with a double rhime, much resembles the measure of Homer and Virgil, except in the length of the lines.

*B.* Then there is no relationship between the other two of these sister-ladies, Painting and Music?

*P.* There is at least a mathematical relationship, or, perhaps, I ought rather to have said, a metaphysical relationship, between them. Sir Isaac Newton has observed, that the breadths of the seven primary colours in the Sun's image, refracted by a prism, are proportional to the seven musical notes of the gamut, or to the intervals of the eight sounds contained in an octave, that is, proportional to the following numbers:

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Sol. | La. | Fa. | Sol. | La. | Mi. | Fa. | Sol. |
| Red. | Orange. | Yellow. | Green. | Blue. | Indigo. | Violet. | |
| $\frac{1}{9}$ | $\frac{1}{16}$ | $\frac{1}{10}$ | $\frac{1}{9}$ | $\frac{1}{16}$ | $\frac{1}{16}$ | $\frac{1}{9}$ | |

Newton's Optics, Book I. part 2. prop. 3 and 6. Dr. Smith, in his Harmonics, has an explanatory note upon this happy discovery, as he terms it, of Newton. Sect. 4. Art. 7.

From this curious coincidence, it has been proposed to produce a luminous music, consisting of successions or combinations of colours, analogous to a tune in respect to the proportions above-mentioned. This might be performed by a strong light, made by means of Mr. Argand's lamps, passing through coloured glasses, and falling on a defined part of a wall, with moveable blinds before them, which might communicate with the keys of a harpsichord, and thus produce, at the same time, visible and audible music in unison with each other.

The execution of this idea is said, by Mr. Guyot, to have been attempted by Father Caffel, without much success.

If this should be again attempted, there is another curious coincidence between sounds and colours, discovered by Dr. Darwin, of Shrewsbury, and explained in a paper on what he calls *Ocular Spectra*, in the Philosophical Transactions, vol. lxxvi. which might much facilitate the execution of it. In this treatise the Doctor has demonstrated, that we see certain colours, not only with greater ease and distinctness, but with relief and pleasure, after having for some time contemplated other certain colours; as green after red, or red after green; orange after blue, or blue after orange; yellow after violet, or violet after yellow. This, he shews, arises from the *ocular spectrum* of the colour last viewed coinciding with the *irritation* of the colour now under contemplation. Now, as the pleasure we receive from the sensation of melodious notes, independent of the previous associations of agreeable ideas with them, must arise from our hearing some proportions of sounds after others more easily, distinctly, or agreeably; and as there is a coincidence between the proportions of the primary colours, and the primary sounds, if they may be so called; he argues, that the same laws must govern the sensations of both. In this circumstance, therefore, consists the sisterhood of Music and Painting; and hence they claim a right to borrow metaphors from each other; musicians to speak of the brilliancy of sounds, and the light and shade of a concerto; and painters of the harmony of colours, and the tone of a picture. Thus it is not quite so absurd as was imagined, when the blind man asked if the colour scarlet was like the sound of a trumpet. As the coincidence or opposition of these *ocular spectra* (or colours which remain in the eye after we have, for some time, contemplated a luminous object), are more easily and more accurately ascertained, now their laws have been investigated by Dr. Darwin, than the *relicts* of evanescent sounds upon the ear, it is to be wished that some ingenious musician would further cultivate this curious field of science: for if visible music can be agreeably produced, it would be more easy to add sentiment to it, by representations of groves and Cupids, and sleeping Nymphs amid the changing colours, than is commonly done by the words of audible music.

*B.* You mentioned the greater length of the verses of Homer and Virgil. Had not these poets great advantage in the superiority of their languages compared to our own?

*P.* It is probable, that the introduction of philosophy into a country must gradually affect the language of it; as philosophy converses in more appropriated and abstracted terms; and thus, by degrees, eradicates the abundance of metaphor, which is used in the more early ages of society. Otherwise, though the Greek compound words have more vowels, in proportion to their consonants, than the English ones, yet the modes of compounding them are less general, as may be seen by variety of instances given in the preface of the translators, prefixed to the SYSTEM OF VEGETABLES by the Lichfield Society; which happy property of our own language rendered that translation of Linnæus as expressive and as concise, perhaps more so than the original.

And, in one respect, I believe the English language serves the purpose of poetry better than the ancient ones; I mean in the greater ease of producing personifications; for as our nouns have, in general, no genders affixed to them in prose-compositions, and in the habits of conversation, they become easily personified only by the addition of a masculine or feminine pronoun, as,

> Pale Melancholy sits, and round *her* throws
> A death-like silence, and a dread repose.
>
> *Pope's Abelard.*

And, secondly, as most of our nouns have the article *a* or *the* prefixed to them in prose-writing and in conversation, they, in general, become personified even by the omission of these articles; as in the bold figure of Shipwreck in Miss Seward's Elegy on Capt. Cook:

> But round the steepy rocks and dangerous strand
> Rolls the white surf, and SHIPWRECK guards the land.

Add to this, that if the verses in our heroic poetry be shorter than those of the ancients, our words likewise are shorter; and, in respect to their measure or time, which has erroneously been called melody and harmony, I doubt, from what has been said above, whether we are so much inferior as is generally believed; since many passages, which have been stolen from ancient poets, have been translated into our language without losing any thing of the beauty of the versification. The following line, translated from Juvenal by Dr. Johnson, is much superior to the original:

> Slow rises Worth by Poverty depress'd.

The original is as follows:

> Difficile emergunt, quorum virtutibus obstat
> Res angusta domi.

*B.* I am glad to hear you acknowledge the thefts of the modern poets from the ancient ones, whose works, I suppose, have been reckoned lawful plunder in all ages. But have not you borrowed epithets, phrases, and even half a line occasionally, from modern poets?

*P.* It may be difficult to mark the exact boundary of what should be termed plagiarism: where the sentiment and expression are both borrowed without due acknowledgment, there can be no doubt;--single words, on the contrary, taken from other authors, cannot convict a writer of plagiarism: they are lawful game, wild by nature, the property of all who can capture them;—and, perhaps, a few common flowers of speech may be gathered, as we pass over our neighbour's inclosure, without stigmatising us with the title of thieves; but we must not, therefore, plunder his cultivated fruit.

The four lines at the end of the plant Upas are imitated from Dr. Young's Night Thoughts. The line in the episode adjoined to Cassia, " The salt tear mingling with the milk he sips," is from an interesting and humane passage in Langhorne's Justice of Peace. There are probably many others, which, if I could recollect them, should here be acknowledged. As it is, like exotic plants, their mixture with the native ones, I hope, adds beauty to my Botanic Garden: and such as it is, *Mr. Bookseller*, I now leave it to you to desire the Ladies and Gentlemen to walk in; but, please to apprize them, that, like the spectators at an unskilful exhibition in some village-barn, I hope they will make Good-humour one of their party; and thus theirselves supply the defects of the representation.

# THE
# BOTANIC GARDEN.

## LOVES OF THE PLANTS.

### CANTO IV.

NOW the broad Sun his golden orb unſhrouds,
Flames in the weſt, and paints the parted clouds;
O'er Heaven's wide arch refracted luſtres flow,
And bend in air the many-colour'd bow.—
—The tuneful Goddeſs on the glowing ſky
Fix'd in mute ecſtaſy her gliſtening eye;
And then her lute to ſweeter tones ſhe ſtrung,
And ſwell'd with ſofter chords the Paphian ſong.
Long ailes of Oaks return'd the ſilver ſound,
And amorous Echoes talk'd along the ground;
Pleaſed Lichfield liſten'd from her ſacred bowers,
Bow'd her tall groves, and ſhook her ſtately towers.

"Nymph! not for thee the radiant day returns,
Nymph! not for thee the golden ſolſtice burns,
Refulgent CEREA!—at the duſky hour
She ſeeks with penſive ſtep the mountain-bower,

*Pleaſed Lichfield.* l. 11. The ſcenery deſcribed at the beginning of the firſt part, or Economy of Vegetation, is taken from a botanic garden about a mile from Lichfield.

*Cerea.* l. 15. Cactus grandiflorus, or Cereus. Twenty males, one female. This flower is a native of Jamaica and Veracrux. It expands a moſt exquiſitely beautiful corol, and emits a moſt fragrant odour for a few hours in the night, and then cloſes to open no more. The flower is nearly a foot in diameter; the inſide of the calyx of a ſplendid yellow, and the numerous petals of a pure white: it begins to open about ſeven or eight o'clock in the evening, and cloſes before ſun-riſe in the morning. Martyn's Letters, p. 294. The Ciſtus labdaniferus, and many other flowers, loſe their petals after having been a few hours expanded in the day-time; for in theſe plants

Bright as the bluſh of riſing morn, and warms
The dull cold eye of Midnight with her charms.
There to the ſkies ſhe lifts her pencil'd brows,
Opes her fair lips, and breathes her virgin vows;
Eyes the white zenyth; counts the ſuns that roll
Their diſtant fires, and blaze around the Pole;
Or marks where Jove directs his glittering car
O'er Heaven's blue vault,—Herſelf a brighter ſtar.
—There as ſoft Zephyrs ſweep with pauſing airs
Thy ſnowy neck, and part thy ſhadowy hairs,
Sweet Maid of Night! to Cynthia's ſober beams
Glows thy warm cheek, thy poliſh'd boſom gleams.
*In crowds* around thee gaze the admiring ſwains,
And guard in ſilence the enchanted plains;
Drop the ſtill tear, or breathe the impaſſion'd ſigh,
And drink inebriate rapture from thine eye.
Thus, when old Needwood's hoary ſcenes the Night
Paints with blue ſhadow, and with milky light;
Where MUNDY pour'd, the liſtening nymphs among,
Loud to the echoing vales his parting ſong;
With meaſured ſtep the Fairy Sovereign treads,
Shakes her high plume, and glitters o'er the meads;
Round each green holly leads her ſportive train,
And little footſteps mark the circled plain;

the ſtigma is ſoon impregnated by the numerous anthers: in many flowers of the Ciſtus labdaniferus, I obſerved two or three of the ſtamens were perpetually bent into contact with the piſtil.

The Nyctanthes, called Arabian Jaſmine, is another flower, which expands a beautiful corol, and gives out a moſt delicate perfume during the night, and not in the day, in its native country, whence its name; botanical philoſophers have not yet explained this wonderful property; perhaps the plant ſleeps during the day as ſome animals do; and its odoriferous glands only emit their fragrance during the expanſion of the petals; that is, during its waking hours; the Geranium triſte has the ſame property of giving up its fragrance only in the night. The flowers of the Cucurbita lagenaria are ſaid to cloſe when the ſun ſhines upon them. In our climate many flowers, as tragopogon, and hibiſcus, cloſe their flowers before the hotteſt part of the day comes on; and the flowers of ſome ſpecies of cucubalus, and Silene, viſcous campion, are cloſed all day; but when the ſun leaves them they expand, and emit a very agreeable ſcent; whence ſuch plants are termed noctiflora.

*Where Mundy.* l. 35. Alluding to an unpubliſhed poem by F. N. C. Mundy, Eſq. on his leaving Needwood-Foreſt. See the paſſage in the notes at the end of this volume.

Each haunted rill with ſilver voices rings,
And Night's ſweet bird in livelier accents ſings.

Ere the bright ſtar, which leads the morning ſky,
Hangs o'er the bluſhing eaſt his diamond eye,
The chaſte Tropæo leaves her ſecret bed;
A ſaint-like glory trembles round her head;
*Eight* watchful ſwains, along the lawns of night,
With amorous ſteps purſue the virgin light;
O'er her fair form the electric luſtre plays,
And cold ſhe moves amid the lambent blaze.
So ſhines the glow-fly, when the ſun retires,
And gems the night-air with phoſphoric fires;
Thus o'er the marſh aerial lights betray,
And charm the unwary wanderer from his way.

*Tropæolum.* l. 45. Majus. Garden Naſturtion, or greater Indian Creſs. Eight males, one female. Miſs E. C. Linnæus firſt obſerved the Tropæolum Majus to emit ſparks or flaſhes in the mornings before ſun-riſe, during the months of June or July, and alſo during the twilight in the evening, but not after total darkneſs came on; theſe ſingular ſcintillations were ſhewn to her father and other philoſophers; and Mr. Wilcke, a celebrated electrician, believed them to be electric. Lin. Spec. Plantar. p. 490. Swediſh Acts for the year 1762. Pulteney's View of Linnæus, p. 220. Nor is this more wonderful than that the electric eel and torpedo ſhould give voluntary ſhocks of electricity; and in this plant, perhaps, as in thoſe animals, it may be a mode of defence, by which it haraſſes or deſtroys the night-flying inſects which infeſt it; and probably it may emit the ſame ſparks during the day, which muſt be then inviſible. This curious ſubject deſerves further inveſtigation. See Dictamnus. The ceaſing to ſhine of this plant after twilight might induce one to conceive, that it abſorbed and emitted light, like the Bolognian Phoſphorus, or calcined oyſter-ſhells, ſo well explained by Mr. B. Wilſon, and by T. B. Beccari. Exper. on Phoſphori, by B. Wilſon. Dodſley. The light of the evening, at the ſame diſtance from noon, is much greater, as I have repeatedly obſerved, than the light of the morning: this is owing, I ſuppoſe, to the phoſphoreſcent quality of almoſt all bodies, in a greater or leſs degree, which thus abſorb light during the ſun-ſhine, and continue to emit it again for ſome time afterwards, though not in ſuch quantity as to produce apparent ſcintillations. The nectary of this plant grows from what is ſuppoſed to be the calyx; but this ſuppoſed calyx is coloured; and, perhaps, from this circumſtance of its bearing the nectary, ſhould rather be eſteemed a part of the corol. See an additional note at the end of the poem.

*So ſhines the glow-fly.* l. 51. In Jamaica, in ſome ſeaſons of the year, the fire-flies are ſeen in the evenings in great abundance. When they ſettle on the ground, the bull-frog greedily devours them; which ſeems to have given origin to a curious, though cruel, method of deſtroying theſe animals: if red-hot pieces of charcoal be thrown towards them in the duſk of the evening, they leap at them, and, haſtily ſwallowing them, are burnt to death.

So when thy King, Aſſyria, fierce and proud,
Three human victims to his idol vow'd;
Rear'd a vaſt pyre before the golden ſhrine
Of ſulphurous coal, and pitch-exſuding pine;—
—Loud roar the flames, the iron noſtrils breathe,
And the huge bellows pant and heave beneath;
Bright and more bright the blazing deluge flows,
And, white with ſevenfold heat, the furnace glows;
And now the Monarch fix'd with dread ſurpriſe
Deep in the burning vault his dazzled eyes.
"Lo! three unbound amid the frightful glare,
"Unſcorch'd their ſandals, and unſing'd their hair!
"And now a fourth with ſeraph-beauty bright
"Deſcends, accoſts them, and outſhines the light!
"Fierce flames innocuous, as they ſtep, retire!
"And ſlow they move amid a world of fire!"
He ſpoke;—to Heaven his arms repentant ſpread,
And, kneeling, bow'd his gem-incircled head.

*Two* Siſter-Nymphs, the fair AVENAS, lead
Their fleecy ſquadrons on the lawns of Tweed;
Paſs with light ſtep his wave-worn banks along,
And wake his Echoes with their ſilver tongue;

*Avena.* l. 73. Oat. The numerous families of graſſes have all three males, and two females, except Anthoxanthum, which gives the grateful ſmell to hay, and has but two males. The herbs of this order of vegetables ſupport the countleſs tribes of graminivorous animals. The ſeeds of the ſmaller kinds of graſſes, as of aira, poa, briza, ſtipa, &c. are the ſuſtenance of many ſorts of birds. The ſeeds of the large graſſes, as of wheat, barley, rye, oats, ſupply food to the human ſpecies.

It ſeems to have required more ingenuity to think of feeding nations of mankind with ſo ſmall a ſeed, than with the potatoe of Mexico, or the bread-fruit of the ſouthern iſlands; hence Ceres, in Egypt, which was the birth-place of our European arts, was deſervedly celebrated amongſt their divinities, as well as Oſyris, who invented the Plough.

Mr. Wahlborn obſerves, that as wheat, rye, and many of the graſſes, and plantain, lift up their anthers on long filaments, and thus expoſe the encloſed fecundating duſt to be waſhed away by the rains, a ſcarcity of corn is produced by wet ſummers; hence the neceſſity of a careful choice of ſeed-wheat, as that which had not received the duſt of the anthers will not grow, though it may appear well to the eye. The ſtraw of the oat ſeems to have been the firſt muſical inſtrument, invented during the paſtoral ages of the world, before the diſcovery of metals. See note on Ciſtus.

Or touch the reed, as gentle Love inſpires,
In notes accordant to their chaſte deſires.

I.

“ Sweet Echo! ſleeps thy vocal ſhell,
“ Where this high arch o'erhangs the dell;
“ While Tweed with ſun-reflecting ſtreams
“ Chequers thy rocks with dancing beams?—

II.

“ Here may no clamours harſh intrude,
“ No brawling hound or clarion rude;
“ Here no fell beaſt of midnight prowl,
“ And teach thy tortured cliffs to howl!

III.

“ Be thine to pour theſe vales along
“ Some artleſs Shepherd's evening ſong;
“ While Night's ſweet bird, from yon high ſpray
“ Reſponſive, liſtens to his lay.

IV.

“ And if, like me, ſome love-lorn maid
“ Should ſing her ſorrows to thy ſhade,
“ Oh, ſooth her breaſt, ye rocks around!
“ With ſofteſt ſympathy of ſound.”

From ozier bowers the brooding Halcyons peep,
The Swans purſuing cleave the glaſſy deep,
On hovering wings the wondering Reed-larks play,
And ſilent Bitterns liſten to the lay.—
*Three* ſhepherd-ſwains beneath the beechen ſhades
Twine rival garlands for the tuneful maids;
On each ſmooth bark the myſtic love-knot frame,
Or on white ſands inſcribe the favour'd name.
Green ſwells the beech, the widening knots improve,
So ſpread the tender growths of living love;
Wave follows wave, the letter'd lines decay,
So Love's ſoft forms uncultured melt away.

From Time's remoteſt dawn where China brings
In proud ſucceſſion all her Patriot-Kings;

O'er deſert-ſands, deep gulphs, and hills ſublime,
Extends her maſſy wall from clime to clime; 110
With bells and dragons creſts her Pagod-bowers,
Her ſilken palaces and porcelain towers;
With long canals a thouſand nations laves;
Plants all her wilds, and peoples all her waves;
Slow treads fair CANNABIS the breezy ſtrand, 115
The diſtaff ſtreams diſhevell'd in her hand;
Now to the left her ivory neck inclines,
And leads in Paphian curves its azure lines;
Dark waves the fringed lid, the warm cheek glows,
And the fair ear the parting locks diſcloſe; 120
Now to the right with airy ſweep ſhe bends,
Quick join the threads, the dancing ſpole depends.
—*Five* Swains attracted guard the Nymph, by turns
Her grace inchants them, and her beauty burns;
To each ſhe bows with ſweet aſſuaſive ſmile, 125
Hears his ſoft vows, and turns her ſpole the while.

So when with light and ſhade, concordant ſtrife!
Stern CLOTHO weaves the chequer'd thread of life;
Hour after hour the growing line extends,
The cradle and the coffin bound its ends; 130
Soft cords of ſilk the whirling ſpoles reveal,
If ſmiling Fortune turn the giddy wheel;
But if ſweet Love with baby-fingers twines,
And wets with dewy lips the lengthening lines,

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*Cannabis*. l. 115. Chineſe Hemp. Two houſes. Five males. A new ſpecies of hemp, of which an account is given by K. Fitzgerald, Eſq. in a letter to Sir Joſeph Banks, and which is believed to be much ſuperior to the hemp of other countries. A few ſeeds of this plant were ſown in England on the 4th of June, and grew to fourteen feet ſeven inches in height by the middle of October: they were nearly ſeven inches in circumference, and bore many lateral branches, and produced very white and tough fibres. At ſome parts of the time theſe plants grew nearly eleven inches in a week. Phil. Tranſ. vol. lxxii. p. 46.

*Paphian curves*. l. 118. In his ingenious work, entitled, The Analyſis of Beauty, Mr. Hogarth believes that the triangular glaſs, which was dedicated to Venus, in her temple at Paphos, contained in it a line bending ſpirally round a cone, with a certain degree of curvature, and that this pyramidal outline and ſerpentine curve conſtitute the principles of Grace and Beauty.

Skein after ſkein celeſtial tints unfold,
And all the ſilken tiſſue ſhines with gold.

Warm with ſweet bluſhes bright Galantha glows,
And prints with frolic ſtep the melting ſnows:
O'er ſilent floods, white hills, and glittering meads,
*Six* rival ſwains the playful beauty leads,
Chides with her dulcet voice the tardy Spring,
Bids ſlumbering Zephyr ſtretch his folded wing,
Wakes the hoarſe Cuckoo in his gloomy cave,
And calls the wondering Dormouſe from his grave,
Bids the mute Redbreaſt cheer the budding grove,
And plaintive Ringdove tune her notes to love.

Spring! with thy own ſweet ſmile and tuneful tongue,
Delighted Bellis calls her infant throng.

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*Galanthus.* l. 137. Nivalis. Snow-drop. Six males, one female. The firſt flower that appears after the winter ſolſtice. See Stillingfleet's Calender of Flora.

Some ſnow-drop-roots, taken up in winter, and boiled, had the inſipid mucilaginous taſte of the Orchis, and, if cured in the ſame manner, would probably make as good ſalep. The roots of the Hyacinth, I am informed, are equally inſipid, and might be uſed as an article of food. Gmelin, in his Hiſtory of Siberia, ſays the Martigon Lily makes a part of the food of that country, which is of the ſame natural order as the ſnow-drop. Some roots of Crocus, which I boiled, had a diſagreeable flavour.

The difficulty of raiſing the Orchis from ſeed has, perhaps, been a principal reaſon of its not being cultivated in this country as an article of food. It is affirmed, by one of the Linnæan School, in the Amœnit. Academ. that the ſeeds of Orchis will ripen, if you deſtroy the new bulb; and that Lily of the Valley, Convallaria, will produce many more ſeeds, and ripen them, if the roots be crowded in a garden-pot, ſo as to prevent them from producing many bulbs, vol. vi. p. 120. It is probable either of theſe methods may ſucceed with theſe and other bulbous-rooted plants, as ſnow-drops, and might render their cultivation profitable in this climate. The root of the aſphodelus ramoſus, branchy aſphodel, is uſed to feed ſwine in France; the ſtarch is obtained from the alſtromeria licta. Memoires d'Agriculture.

*Bellis prolifera.* l. 148. Hen and chicken Daiſy. In this beautiful monſter not only the impletion, or doubling of the petals, takes place, as deſcribed in the note on Alcea, but a numerous circlet of leſs flowers on peduncles, or foot-ſtalks, riſe from the ſides of the calyx, and ſurround the proliferous parent. The ſame occurs in Calendula, marigold; in Heracium, hawkweed; and in Scabioſa, ſcabious. Phil. Bot. p. 82.

Each on his reed aſtride, the Cherub-train
Watch her kind looks, and circle o'er the plain; 150
Now with young wonder touch the ſliding ſnail,
Admire his eye-tipp'd horns, and painted mail;
Chaſe with quick ſtep, and eager arms outſpread,
The pauſing Butterfly from mead to mead;
Or twine green oziers with the fragrant Gale, 155
The azure harebel, and the primroſe pale,
Join hand in hand, and in proceſſion gay
Adorn with votive wreaths the ſhrine of May.
—So moves the Goddeſs to the Idalian groves,
And leads her gold-hair'd family of Loves. 160
Theſe, from the flaming furnace, ſtrong and bold,
Pour the red ſteel in many a ſandy mould;
On tinkling anvils (with Vulcanian art)
Turn with hot tongs, and forge the dreadful dart;
The barbed head on whirling jaſpers grind, 165
And dip the point in poiſon for the mind;
Each poliſh'd ſhaft with ſnow-white plumage wing,
Or ſtrain the bow reluctant to its ſtring.
Thoſe on light pinion twine with buſy hands,
Or ſtretch from bough to bough the flowery bands; 170
Scare the dark beetle, as he wheels on high,
Or catch in ſilken nets the gilded fly;
Call the young Zephyrs to their fragrant bowers,
And ſtay with kiſſes ſweet the Vernal Hours.

Where, as proud Maſſon riſes rude and bleak, 175
And with miſhapen turrets creſts the Peak,

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*The fragrant Gale.* l. 155. The buds of the Myrica Gale poſſeſs an agreeable aromatic fragrance, and might be worth attending to as an article of the Materia Medica. Mr. Sparman ſuſpects, that the green wax-like ſubſtance, with which, at certain times of the year, the berries of the Myrica cerifera, or candle-berry Myrtle, are covered, are depoſited there by inſects. It is uſed by the inhabitants for making candles, which, he ſays, burn rather better than thoſe made of tallow. Voyage to the Cape, vol. i. p. 345. Du Halde gives an account of a white wax, made by ſmall inſects, round the branches of a tree in China, in great quantity, which is there collected for medical and economical purpoſes. The tree is called Tong-tſin. Deſcrip. of China, vol. i. p. 230.

Old Matlock gapes with marble jaws, beneath,
And o'er ſcar'd Derwent bends his flinty teeth;
Deep in wide caves below the dangerous ſoil
Blue ſulphurs flame, impriſon'd waters boil.
Impetuous ſteams in ſpiral columns riſe
Through rifted rocks, impatient for the ſkies;
Or o'er bright ſeas of bubbling lavas blow,
As heave and toſs the billowy fires below;
Condenſed on high, in wandering rills they glide
From Maſſon's dome, and burſt his ſparry ſide;
Round his grey towers, and down his fringed walls,
From cliff to cliff, the liquid treaſure falls;
In beds of ſtalactite, bright ores among,
O'er corals, ſhells, and cryſtals, winds along;
Cruſts the green moſſes, and the tangled wood,
And ſparkling plunges to its parent flood.
—O'er the warm wave a ſmiling youth preſides,
Attunes its murmurs, its meanders guides,

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*Deep in wide caves.* l. 179. The arguments which tend to ſhew that the warm ſprings of this country are produced from ſteam raiſed by deep ſubterraneous fires, and afterwards condenſed between the ſtrata of the mountains, appear to me much more concluſive than the idea of their being warmed by chemical combinations near the ſurface of the earth; for, firſt, their heat has kept accurately the ſame, perhaps, for many centuries, certainly as long as we have been poſſeſſed of good thermometers; which cannot be well explained, without ſuppoſing that they are firſt in a boiling ſtate. For, as the heat of boiling water is 212, and that of the internal parts of the earth 48, it is eaſy to underſtand, that the ſteam raiſed from boiling water, after being condenſed in ſome mountain, and paſſing from thence through a certain ſpace of the cold earth, muſt be cooled always to a given degree; and, it is probable, the diſtance from the exit of the ſpring to the place where the ſteam is condenſed, might be gueſſed by the degree of its warmth.

2. In the dry ſummer of 1780, when all other ſprings were either dry or much diminiſhed, thoſe of Buxton and Matlock (as I was well informed on the ſpot) had ſuffered no diminution; which proves that the ſources of theſe warm ſprings are at great depths below the ſurface of the earth.

3. There are numerous perpendicular fiſſures in the rocks of Derbyſhire, in which the ores of lead and copper are found, and which paſs to unknown depths, and might thence afford a paſſage to ſteam from great ſubterraneous fires.

4. If theſe waters were heated by the decompoſition of pyrites, there would be ſome chalybeate taſte or ſulphureous ſmell in them. See note in part I. on the exiſtence of central fires.

(The blooming FUCUS) in her ſparry coves
To amorous Echo ſings his *ſecret* loves,
Bathes his fair forehead in the miſty ſtream,
And with ſweet breath perfumes the riſing ſteam.
—So, erſt, an Angel o'er Betheſda's ſprings,
Each morn deſcending, ſhook his dewy wings;
And as his bright tranſlucent form He laves
Salubrious powers enrich the troubled waves.

Amphibious Nymph, from Nile's prolific bed
Emerging TRAPA lifts her pearly head;

*Fucus.* l. 195. Clandeſtine marriage. A ſpecies of Fucus, or of Conferva, ſoon appears in all baſons which contain water. Dr. Prieſtley found, that great quantities of pure dephlogiſticated air were given up in water at the points of this vegetable, particularly in the ſunſhine, and that hence it contributed to preſerve the water in reſervoirs from becoming putrid. The minute diviſions of the leaves of ſubaquatic plants, as mentioned in the note on Trapa, and of the gills of fiſh, ſeem to ſerve another purpoſe beſides that of increaſing their ſurface, which has not, I believe, been attended to, and that is, to facilitate the ſeparation of the air, which is mechanically mixed, or chemically diſſolved in water, by their points or edges: this appears on immerſing a dry hairy leaf in water freſh from a pump; innumerable globules, like quick-ſilver, appear on almoſt every point; for the extremities of theſe points attract the particles of water leſs forcibly than thoſe particles attract each other; hence the contained air, whoſe elaſticity was but juſt balanced by the attractive power of the ſurrounding particles of water to each other, finds, at the point of each fibre, a place where the reſiſtance to its expanſion is leſs; and, in conſequence, it there expands, and becomes a bubble of air. It is eaſy to foreſee that the rays of the ſunſhine, by being refracted, and, in part, reflected by the two ſurfaces of theſe minute air-bubbles, muſt impart to them much more heat than to the tranſparent water, and thus facilitate their aſcent by further expanding them: that the points of vegetables attract the particles of water leſs than they attract each other, is ſeen by the ſpherical form of dew-drops on the points of graſs. See note on Vegetable Reſpiration, in part I.

*Trapa.* l. 204. Four males, one female. The lower leaves of this plant grow under water, and are divided into minute capillary ramifications; while the upper leaves are broad and round, and have air-bladders in their footſtalks to ſupport them above the ſurface of the water. As the aërial leaves of vegetables do the office of lungs, by expoſing a large ſurface of veſſels, with their contained fluids, to the influence of the air; ſo theſe aquatic leaves anſwer a ſimilar purpoſe, like the gills of fiſh; and perhaps gain from water, or give to it, a ſimilar material. As the material thus neceſſary to life ſeems to abound more in air than in water, the ſubaquatic leaves of this plant, and of ſiſymbrium, œnanthe, ranunculus aquatilis, water crowfoot, and ſome others, are cut into fine diviſions to increaſe the ſurface; whilſt thoſe above water are undivided. So the plants on high mountains have their upper leaves more divided, as pimpinella, petroſelinum, and others, becauſe here

Fair glows her virgin cheek and modeſt breaſt, 205
A panoply of ſcales deforms the reſt;
Her quivering fins and panting gills ſhe hides,
But ſpreads her ſilver arms upon the tides;
Slow as ſhe ſails, her ivory neck ſhe laves,
And ſhakes her golden treſſes o'er the waves. 210
Charm'd round the Nymph, in circling gambols glide
*Four* Nereid-forms, or ſhoot along the tide;
Now all as one they riſe with frolic ſpring,
And beat the wondering air on humid wing;
Now all deſcending plunge beneath the main, 215
And laſh the foam with undulating train;
Above, below, they wheel, retreat, advance,
In air and ocean weave the mazy dance;
Bow their quick heads, and point their diamond eyes,
And twinkle to the ſun with ever-changing dyes. 220

Where Andes, creſted with volcanic beams,
Sheds a long line of light on Plata's ſtreams;
Opes all his ſprings, unlocks his golden caves,
And feeds and freights the immeaſurable waves;

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the air is thinner, and thence a larger ſurface of contact is required. The ſtream of water alſo paſſes but once along the gills of fiſh, as it is ſooner deprived of its virtue; whereas the air is both received and ejected by the action of the lungs of land-animals. The whale ſeems to be an exception to the above, as he receives water and ſpouts it out again from an organ, which I ſuppoſe to be a reſpiratory one. As ſpring-water is nearly of the ſame degree of heat in all climates, the aquatic plants, which grow in rills or fountains, are found equally in the torrid, temperate, and frigid zones, as water-creſs, water-parſnip, ranunculus, and many others.

In warmer climates the watery grounds are uſually cultivated, as with rice; and the roots of ſome aquatic plants are ſaid to have ſupplied food, as the ancient Lotus in Egypt, which ſome have ſuppoſed to be the Nymphæa.— In Siberia the roots of the Butomus, or flowering ruſh, are eaten, which is well worth further inquiry, as they grow ſpontaneouſly in our ditches and rivers, which at preſent produce no eſculent vegetables; and might thence become an article of uſeful cultivation. Herodotus affirms, that the Egyptian Lotus grows in the Nile, and reſembles a Lily. That the natives dry it in the ſun, and take the pulp out of it, which grows like the head of a poppy, and bake it for bread. Euterpe. Many grit-ſtones and coals, which I have ſeen, ſeem to bear an impreſſion of the roots of the Nymphæa, which are often three or four inches thick, eſpecially the white-flowered one.

Delighted OCYMA at twilight hours
Calls her light car, and leaves the ſultry bowers;
Love's riſing ray, and Youth's ſeductive dye,
Bloom'd on her cheek, and brighten'd in her eye;
Chaſte, pure, and white, a zone of ſilver graced
Her tender breaſt, as white, as pure, as chaſte;—
By *four* fond ſwains in playful circles drawn,
On glowing wheels ſhe tracks the moon-bright lawn,
Mounts the rude cliff, unveils her bluſhing charms,
And calls the panting zephyrs to her arms.
Emerged from ocean ſprings the vaporous air,
Bathes her light limbs, uncurls her amber hair,
Incruſts her beamy form with films ſaline,
And Beauty blazes through the cryſtal ſhrine.—
So with pellucid ſtuds the ice-flower gems
Her rimy foliage, and her candied ſtems.

*Ocymum ſalinum.* l. 225. Saline Baſil. Claſs Two Powers. The Abbé Molina, in his Hiſtory of Chili, tranſlated from the Italian by the Abbé Grewvel, mentions a ſpecies of Baſil, which he calls Ocymum ſalinum: he ſays it reſembles the common baſil, except that the ſtalk is round and jointed; and that though it grows ſixty miles from the ſea, yet every morning it is covered with ſaline globules, which are hard and ſplendid, appearing at a diſtance like dew; and that each plant furniſhes about half an ounce of fine ſalt every day, which the peaſants collect, and uſe as common ſalt, but eſteem it ſuperior in flavour.

As an article of diet, ſalt ſeems to act ſimply as a ſtimulus, not containing any nouriſhment, and is the only foſſil ſubſtance which the caprice of mankind has yet taken into their ſtomachs along with their food; and, like all other unnatural ſtimuli, is not neceſſary to people in health, and contributes to weaken our ſyſtem, though it may be uſeful as a medicine. It ſeems to be the immediate cauſe of the ſea-ſcurvy, as thoſe patients quickly recover by the uſe of freſh proviſions; and is, probably, a remote cauſe of ſcrophula, (which conſiſts in the want of irritability in the abſorbent veſſels,) and is, therefore, ſerviceable to theſe patients, as wine is neceſſary to thoſe whoſe ſtomachs have been weakened by its uſe. The univerſality of the uſe of ſalt with our food, and in our cookery, has rendered it difficult to prove the truth of theſe obſervations. I ſuſpect that fleſh-meat, cut into thin ſlices, either raw or boiled, might be preſerved in coarſe ſugar or treacle; and thus a very nouriſhing and ſalutary diet might be preſented to our ſeamen. See note on Salt-rocks, in part i. Canto II. If a perſon, unaccuſtomed to much ſalt, ſhould eat a couple of red herrings, his inſenſible perſpiration will be ſo much increaſed by the ſtimulus of the ſalt, that he will find it neceſſary, in about two hours, to drink a quart of water: the effects of a continued uſe of ſalt in weakening the action of the lymphatic ſyſtem, may hence be deduced.

So from his glaſſy horns, and pearly eyes,
The diamond-beetle darts a thouſand dyes;
Mounts with enamel'd wings the veſper gale,
And wheeling ſhines in adamantine mail.

Thus when loud thunders o'er Gomorrah burſt,
And heaving earthquakes ſhook his realms accurſt,
An Angel-gueſt led forth the trembling Fair
With ſhadowy hand, and warn'd the guiltleſs pair;
" Haſte from theſe lands of ſin, ye Righteous! fly,
" Speed the quick ſtep, nor turn the lingering eye!"—
—Such the command, as fabling Bards recite,
When Orpheus charm'd the griſly King of Night;
Sooth'd the pale phantoms with his plaintive lay,
And led the fair Aſſurgent into day.—
Wide yawn'd the earth, the fiery tempeſt flaſh'd,
And towns and towers in one vaſt ruin craſh'd;—
Onward they move,—loud horror roars behind,
And ſhrieks of Anguiſh bellow in the wind.
With many a ſob, amid a thouſand fears,
The beauteous wanderer pours her guſhing tears;
Each ſoft connection rends her troubled breaſt,
—She turns, unconſcious of the ſtern beheſt!—
" I faint!—I fall!—ah, me!—ſenſations chill
" Shoot through my bones, my ſhuddering boſom thrill!
" I freeze! I freeze! juſt Heaven regards my fault,
" Numbs my cold limbs, and hardens into ſalt!—
" Not yet, not yet, your dying love reſign!—
" This laſt, laſt kiſs receive!—no longer thine!"—
She ſaid, and ceaſed,—her ſtiffen'd form He preſs'd,
And ſtrain'd the briny column to his breaſt;
Printed with quivering lips the lifeleſs ſnow,
And wept, and gazed the monument of woe.
So when Æneas through the flames of Troy
Bore his pale ſire, and led his lovely boy,
With loitering ſtep the fair Creuſa ſtay'd,
And Death involved her in eternal ſhade.—
—Oft the lone Pilgrim, that his road forſakes,
Marks the wide ruins, and the ſulphur'd lakes;

On mouldering piles amid aſphaltic mud
Hears the hoarſe bittern, where Gomorrah ſtood;
Recals the unhappy Pair with lifted eye,
Leans on the cryſtal tomb, and breathes the ſilent ſigh.

With net-wove ſaſh and glittering gorget dreſs'd,
And ſcarlet robe lapell'd upon her breaſt,
Stern ARA frowns, the meaſured march aſſumes,
Trails her long lance, and nods her ſhadowy plumes;
While Love's ſoft beams illume her treacherous eyes,
And Beauty lightens through the thin diſguiſe.
So erſt, when HERCULES, untamed by toil,
Own'd the ſoft power of DEJANIRA's ſmile;—
His lion-ſpoils the laughing Fair demands,
And gives the diſtaff to his awkward hands;
O'er her white neck the briſtly mane ſhe throws,
And binds the gaping whiſkers on her brows;
Plaits round her ſlender waiſt the ſhaggy veſt,
And claſps the velvet paws acroſs her breaſt.

*Arum.* l. 285. Cuckow-pint, of the claſs Gynandria, or maſculine ladies. The piſtil, or female part of the flower, riſes like a club, is covered above, or clothed, as it were, by the anthers or males; and ſome of the ſpecies have a large ſcarlet blotch in the middle of every leaf.

The ſingular and wonderful ſtructure of this flower has occaſioned many diſputes amongſt botaniſts. See Tourniff. Malpig. Dillen. Riven. &c. The receptacle is enlarged into a naked club, with the germs at its baſe; the ſtamens are affixed to the receptacle amidſt the germs (a natural prodigy), and thus do not need the aſſiſtance of elevating filaments: hence the flower may be ſaid to be inverted. *Families of Plants*, tranſlated from Linnæus, p. 618.

The ſpadix of this plant is frequently quite white, or coloured, and the leaves liable to be ſtreaked with white, and to have black or ſcarlet blotches on them. As the plant has no corol or bloſſom, it is probable the coloured juices in theſe parts of the ſheath or leaves may ſerve the ſame purpoſe as the coloured juices in the petals of other flowers; from which I ſuppoſe the honey to be prepared. See note on Helleborus. I am informed that thoſe tulip-roots which have a red cuticle produce red flowers. See Rubia.

When the petals of the tulip become ſtriped with many colours, the plant loſes almoſt half of its height; and the method of making them thus break into colours, is by tranſplanting them into a meagre or ſandy ſoil, *after they have previouſly enjoyed a richer ſoil:* hence it appears, that the plant is weakened when the flower becomes variegated. See note on Anemone. For the acquired habits of vegetables, ſee Tulipa, Orchis.

The roots of the Arum are ſcratched up, and eaten by thruſhes in ſevere ſnowy ſeaſons. White's Hiſt. of Selbourn, p. 43.

Next with ſoft hands the knotted club ſhe rears,
Heaves up from earth, and on her ſhoulder bears.
Onward with loftier ſtep the Beauty treads,
And trails the brinded ermine o'er the meads;
Wolves, bears, and pards, forſake the affrighted groves,
And grinning Satyrs tremble, as ſhe moves.

CARYO's ſweet ſmile DIANTHUS proud admires,
And gazing burns with unallow'd deſires;
With ſighs and ſorrows her compaſſion moves,
And wins the damſel to illicit loves.
The Monſter-offspring heirs the father's pride,
Maſk'd in the damaſk beauties of the bride.
So, when the Nightingale in eaſtern bowers
On quivering pinion woos the Queen of Flowers;

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*Dianthus.* l. 303. Superbus. Proud Pink. There is a kind of pink, called Fairchild's mule, which is here ſuppoſed to be produced between a Dianthus ſuperbus, and the Caryophyllus, Clove. The Dianthus ſuperbus emits a moſt fragrant odour, particularly at night. Vegetable mules ſupply an irrefragable argument in favour of the ſexual ſyſtem of botany. They are ſaid to be numerous; and, like the mules of the animal kingdom, not always to continue their ſpecies by ſeed. There is an account of a curious mule from the Antirrhinum linaria, Toad-flax, in the Amœnit. Academ. vol. i. No. 3. and many hybrid plants deſcribed in No. 32. The Urtica alienata is an evergreen plant, which appears to be a nettle from the male flowers, and a Pellitory (Parietaria) from the female ones and the fruit; and is hence between both. Murray, Syſt. Veg. Amongſt the Engliſh indigenous plants, the veronica hybrida mule Speedwel is ſuppoſed to have originated from the officinal one, and the ſpiked one. And the Sibthorpia Europæa to have for its parents the golden ſaxifrage and marſh pennywort. Pulteney's View of Linnæus, p. 253. Mr. Graberg, Mr. Schreber, and Mr. Ramſtrom, ſeem of opinion, that the internal ſtructure, or parts of fructification in mule-plants, reſemble the female parent; but that the habit, or external ſtructure, reſembles the male parent. See treatiſes under the above names, in vol. vi. Amœnit. Academic. The mule produced from a horſe and the aſs, reſembles the horſe externally with his ears, mane, and tail; but with the nature or manners of an aſs: but the Hinnus, or creature produced from a male aſs and a mare, reſembles the father externally in ſtature, aſh-colour, and the black croſs, but with the nature or manners of a horſe. The breed from Spaniſh rams and Swediſh ewes reſembled the Spaniſh ſheep in wool, ſtature, and external form; but was as hardy as the Swediſh ſheep; and the contrary of thoſe which were produced from Swediſh rams and Spaniſh ewes. The offspring from the male goat of Angora, and the Swediſh female goat, had long ſoft camel's hair; but that from the male Swediſh goat, and the female one of Angora, had no improvement of their wool. An Engliſh ram without horns, and a Swediſh horned ewe, produced ſheep without horns. Amœn. Acad. vol. vi. p. 13.

Inhales her fragrance, as he hangs in air,
And melts with melody the bluſhing fair;
Half-roſe, half-bird, a beauteous Monſter ſprings,
Waves his thin leaves, and claps his gloſſy wings;
Long horrent thorns his moſſy legs ſurround,
And tendril-talons root him to the ground;
Green films of rind his wrinkled neck o'erſpread,
And crimſon petals creſt his curled head;
Soft-warbling beaks in each bright bloſſom move,
And vocal Roſebuds thrill the enchanted grove!—
Admiring Evening ſtays her beamy ſtar,
And ſtill Night liſtens from his ebon car;
While on white wings deſcending Houries throng,
And drink the floods of odour and of ſong.

When from his golden urn the Solſtice pours
O'er Afric's ſable ſons the ſultry hours;
When not a gale flits o'er her tawny hills,
Save where the dry Harmattan breathes and kills;

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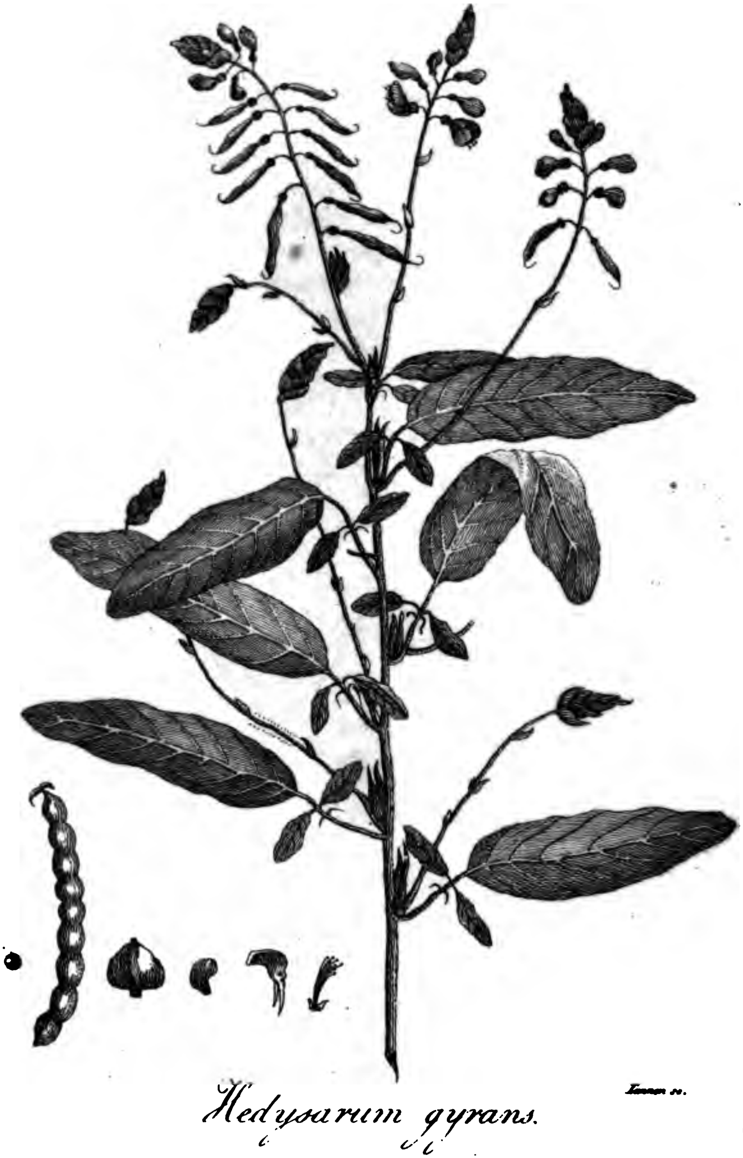
*The dry Harmattan.* l. 328. The Harmattan is a ſingular wind, blowing from the interior parts of Africa to the Atlantic ocean, ſometimes for a few hours, ſometimes for ſeveral days, without regular periods. It is always attended with a fog or haze, ſo denſe as to render thoſe objects inviſible which are at the diſtance of a quarter of a mile: the ſun appears through it only about noon, and then of a dilute red, and very minute particles ſubſide from the miſty air, ſo as to make the graſs, and the ſkins of negroes, appear whitiſh. The extreme dryneſs which attends this wind or fog, without dews, withers, and quite dries, the leaves of vegetables; and is ſaid, by Dr. Lind, at ſome ſeaſons, to be fatal and malignant to mankind; probably after much preceding wet, when it may become loaded with the exhalations from putrid marſhes: at other ſeaſons it is ſaid to check epidemic diſeaſes, to cure fluxes, and to heal ulcers and cutaneous eruptions; which is, probably, effected by its yielding no moiſture to the mouths of the external abſorbent veſſels, by which the action of the other branches of the abſorbent ſyſtem is increaſed to ſupply the deficiency. *Account of the Harmattan, Phil. Tranſ.* vol. lxxi.

The Reverend Mr. Sterling gives an account of a darkneſs for ſix or eight hours at Detroit, in America, on the 19th of October, 1762, in which the ſun appeared as red as blood, and thrice its uſual ſize: ſome rain falling, covered white paper with dark drops, like ſulphur or dirt, which burnt like wet gun-powder, and the air had a very ſulphureous ſmell. He ſuppoſes this to have been emitted from ſome diſtant earthquake or volcano. Phil. Tranſ. vol. liii. p. 63.

In many circumſtances this wind ſeems much to reſemble the dry fog which covered moſt parts of Europe, for many weeks, in the ſummer of



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Hedysarum gyrans.

When ſtretch'd in duſt her gaſping panthers lie,
And writh'd in foamy folds her ſerpents die; 330
Indignant Atlas mourns his leafleſs woods,
And Gambia trembles for his ſinking floods;
Contagion ſtalks along the briny ſand,
And Ocean rolls his ſickening ſhoals to land.
—Fair Chunda ſmiles amid the burning waſte, 335
Her brow unturban'd, and her zone unbraced;
*Ten* brother-youths with light umbrella's ſhade,
Or fan with buſy hands the panting maid;

1780, which has been ſuppoſed to have had a volcanic origin, as it ſucceeded the violent eruption of Mount Hecla, and its neighbourhood. From the ſubſidence of a white powder, it ſeems probable that the Harmattan has a ſimilar origin, from the unexplored mountains of Africa. Nor is it improbable, that the epidemic coughs, which occaſionally traverſe immenſe tracts of country, may be the products of volcanic eruptions; nor impoſſible, that at ſome future time, contagious miaſmata may be thus emitted from ſubterraneous furnaces, in ſuch abundance as to contaminate the whole atmoſphere, and depopulate the earth!

*His ſickening ſhoals.* l. 334. Mr. Marſden relates, that in the iſland of Sumatra, during the November of 1775, the dry monſoons, or S. E. winds, continued ſo much longer than uſual, that the large rivers became dry; and prodigious quantities of ſea-fiſh, dead and dying, were ſeen floating for leagues on the ſea, and driven on the beach by the tides. This was ſuppoſed to have been cauſed by the great evaporation, and the deficiency of freſh-water rivers having rendered the ſea too ſalt for its inhabitants. The ſeaſon then became ſo ſickly as to deſtroy great numbers of people, both foreigners and natives. Phil. Tranſ. vol. lxxi. p. 384.

*Chunda.* l. 335. Chundali Borrum is the name which the natives give to this plant: it is the Hedyſarum gyrans, or moving plant: its claſs is two brotherhoods, ten males. Its leaves are continually in ſpontaneous motion; ſome riſing and others falling; and others whirling circularly by twiſting their ſtems. This ſpontaneous movement of the leaves, when the air is quite ſtill and very warm, ſeems to be neceſſary to the plant, as perpetual reſpiration is to animal life. A more particular account, with a good print of the Hedyſarum gyrans, is given by M. Brouſſonet, in a paper on vegetable motions, in the Hiſtoire de l'Academie des Sciences. Ann. 1784. p. 609.

There are many other inſtances of ſpontaneous movements of the parts of vegetables. In the Marchantia polymorpha, ſome yellow wool proceeds from the flower-bearing anthers, which moves ſpontaneouſly in the anther, while it drops its duſt like atoms. Murray, Syſt. Veg. See note on Collinſonia, for other inſtances of vegetable ſpontaneity. Add to this, that as the ſleep of animals conſiſts in a ſuſpenſion of voluntary motion, and as vegetables are likewiſe ſubject to ſleep, there is reaſon to conclude, that the various actions of opening and cloſing their petals and foliage may be juſtly aſcribed to a voluntary power: for without the faculty of volition, ſleep would not have been neceſſary to them.

Looſe wave her locks, diſcloſing as they break,
The riſing boſom and averted cheek;
Claſp'd round her ivory neck with ſtuds of gold
Flows her thin veſt in many a gauzy fold;
O'er her light limbs the dim tranſparence plays,
And the fair form, it ſeems to hide, betrays.

Cold from a thouſand rocks, where Ganges leads
The guſhing waters to his ſultry meads;
By moon-crown'd moſques with gay reflections glides,
And vaſt pagodas trembling on his ſides;
With ſweet loquacity NELUMBO ſails,
Shouts to his ſhores, and parleys with his gales;
Invokes his echoes, as ſhe moves along,
And thrills his ripling ſurges with her ſong.
—As round the Nymph her liſtening lovers play,
And guard the Beauty on her watery way;
Charm'd on the brink relenting tygers gaze,
And pauſing buffaloes forget to graze;
Admiring elephants forſake their woods,
Stretch their wide ears, and wade into the floods;
In ſilent herds the wondering ſea-calves lave,
Or nod their ſlimy foreheads o'er the wave;
Poiſed on ſtill wing attentive vultures ſweep,
And winking crocodiles are lull'd to ſleep.

Where leads the northern Star his lucid train
High o'er the ſnow-clad earth, and icy main,
With milky light the white horizon ſtreams,
And to the moon each ſparkling mountain gleams.—

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*Nelumbo.* l. 349. Nymphæa Nelumbo. A beautiful roſe-red flower on a receptacle as large as an artichoke. The capſule is perforated with holes at the top, and the ſeeds rattle in it. Perfect leaves are ſeen in the ſeeds before they germinate. Linnæus, who has enliſted all our ſenſes into the ſervice of botany, has obſerved this rattling of the Nelumbo; and mentions what he calls an electric murmur, like diſtant thunder, in hop-yards, when the wind blows, and aſks the cauſe of it. We have one kind of pedicularis in our meadows, which has obtained the name of rattle-graſs, from the rattling of its dry ſeed-veſſels under our feet.

Slow o'er the printed ſnows with ſilent walk
Huge ſhaggy forms acroſs the twilight ſtalk;
And ever and anon with hideous ſound
Burſt the thick ribs of ice, and thunder round.— 370
There, as old Winter flaps his hoary wing,
And lingering leaves his empire to the Spring,
Pierced with quick ſhafts of ſilver-ſhooting light
Fly in dark troops the dazzled imps of night.—
" Awake, my Love!" enamour'd MUSCHUS cries, 375
" Stretch thy fair limbs, refulgent Maid! ariſe;
" Ope thy ſweet eye-lids to the riſing ray,
" And hail with ruby lips returning day.
" Down the white hills diſſolving torrents pour,
" Green ſprings the turf, and purple blows the flower; 380
" His torpid wing the Rail exulting tries,
" Mounts the ſoft gale, and wantons in the ſkies;
" Riſe, let us mark how bloom the awaken'd groves,
" And 'mid the banks of roſes *hide* our loves."

Night's tinſel beams on ſmooth Lock-lomond dance, 385
Impatient ÆGA views the bright expanſe;

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*Burſt the thick ribs of ice.* l. 370. The violent cracks of ice heard from the Glaciers, ſeem to be cauſed by ſome of the ſnow being melted in the middle of the day; and the water thus produced running down into vallies of ice, and, congealing again in a few hours, forces off, by its expanſion, large precipices from the ice-mountains.

*Muſchus.* l. 375. Corallinus, or lichen rangiferinus. Coral-moſs. Clandeſtine marriage. This moſs vegetates beneath the ſnow, where the degree of heat is always about 40; that is, in the middle, between the freezing point and the common heat of the earth; and is, for many months of the winter, the ſole food of the rein-deer, who digs furrows in the ſnow to find it; and as the milk and fleſh of this animal is almoſt the only ſuſtenance which can be procured during the long winters of the higher latitudes, this moſs may be ſaid to ſupport ſome millions of mankind.

The quick vegetation that occurs on the ſolution of the ſnows in high latitudes, appears very aſtoniſhing: it ſeems to ariſe from two cauſes; 1. The long continuance of the approaching ſun above the horizon; 2. The increaſed irritability of plants which have been long expoſed to the cold. See note on Anemone.

All the water-fowl on the lakes of Siberia are ſaid, by Profeſſor Gmelin, to retreat ſouthwards on the commencement of the froſt, except the Rail, which ſleeps buried in the ſnow. Account of Siberia.

*Æga.* l. 386. Conferva ægagropila. It is found looſe in many lakes, in a globular form, from the ſize of a walnut to that of a melon, much re-

In vain her eyes the paſſing floods explore,
Wave after wave rolls freightleſs to the ſhore.
—Now dim amid the diſtant foam ſhe ſpies
A riſing ſpeck,—"'tis he! 'tis he!" ſhe cries;
As with firm arms he beats the ſtreams aſide,
And cleaves with riſing cheſt the toſſing tide,
With bended knee ſhe prints the humid ſands,
Up-turns her gliſtening eyes, and ſpreads her hands;
—"'Tis he, 'tis he!—My Lord, my life, my love!
" Slumber, ye winds; ye billows, ceaſe to move!
" Beneath his arms your buoyant plumage ſpread,
" Ye Swans! ye Halcyons! hover round his head!"—
—With eager ſtep the boiling ſurf ſhe braves,
And meets her refluent lover in the waves;
Looſe o'er the flood her azure mantle ſwims,
And the clear ſtream betrays her ſnowy limbs.

So on her ſea-girt tower fair HERO ſtood
At parting day, and mark'd the daſhing flood;
While high in air, the glimmering rocks above,
Shone the bright lamp, the pilot-ſtar of love.
—With robe outſpread the wavering flame behind
She kneels, and guards it from the ſhifting wind;
Breathes to her Goddeſs all her vows, and guides
Her bold LEANDER o'er the duſky tides;
Wrings his wet hair, his briny boſom warms,
And claſps her panting lover in her arms.

Deep, in wide caverns and their ſhadowy ailes,
Daughter of Earth, the chaſte TRUFFELIA ſmiles;

ſembling the balls of hair found in the ſtomachs of cows: it adheres to nothing, but rolls from one part of the lake to another. The Conferva vagabunda dwells on the European ſeas, travelling along in the midſt of the waves. (Spec. Plant.) Theſe may not improperly be called itinerant vegetables. In a ſimilar manner the Fucus natans (ſwimming) ſtrikes no roots into the earth, but floats on the ſea in very extenſive maſſes, and may be ſaid to be a plant of paſſage, as it is wafted by the winds from one ſhore to another.

*Truffelia.* l. 414. (Lycoperdon Tuber) Truffle. Clandeſtine marriage. This fungus never appears above ground, requiring little air, and, perhaps,

On ſilvery beds, of ſoft aſbeſtus wove, 415
Meets her Gnome-huſband, and avows her love.
—*High* o'er her couch impending diamonds blaze,
And branching gold the cryſtal roof inlays;
With verdant light the modeſt emeralds glow,
Blue ſapphires glare, and rubies bluſh, *below*; 420
Light piers of lazuli the dome ſurround,
And pictured mochoes teſſelate the ground;*
In glittering threads along reflective walls
The warm rill murmuring twinkles, as it falls;
Now ſink the Eolian ſtrings, and now they ſwell, 425
And Echoes woo in every vaulted cell;
While on white wings delighted Cupids play,
Shake their bright lamps, and ſhed celeſtial day.

Cloſed in an azure fig by fairy ſpells,
Boſom'd in down, fair Capri-fica dwells;— 430

no light. It is found by dogs or ſwine, who hunt it by the ſmell. Other plants which have no buds or branches on their ſtems, as the graſſes, ſhoot out numerous ſtoles or ſcions under ground; and this the more, as their tops or herbs are eaten by cattle, and thus preſerve themſelves.

*Capri-ficus.* l. 430. Wild fig. The fruit of the fig is not a ſeed-veſſel, but a receptacle incloſing the flower within it. As theſe trees bear ſome male and others female flowers, immured on all ſides by the fruit, the manner of their fecundation was very unintelligible, till Tournefort and Pontedera diſcovered, that a kind of gnat, produced in the male figs, carried the fecundating duſt on its wings, (Cynips Pſenes Syſt. Nat. 919.) and, penetrating the female fig, thus impregnated the flowers. For the evidence of this wonderful fact, ſee the word Caprification, in Milne's Botanical Dictionary. The figs of this country are all female, and their ſeeds not prolific; and, therefore, they can only be propagated by layers and ſuckers.

Monſieur de la Hire has ſhewn, in the Memoir. de l'Academ. de Science, that the ſummer figs of Paris, in Provence, Italy, and Malta, have all perfect ſtamina, and ripen not only their fruits, but their ſeed; from which ſeed other fig-trees are raiſed; but that the ſtamina of the autumnal figs are abortive, perhaps owing to the want of due warmth. Mr. Milne, in his Botanical Dictionary (art. Caprification), ſays, that the cultivated fig-trees have a few male flowers placed above the female within the ſame covering or receptacle; which, in warmer climates, perform their proper office, but in colder ones become abortive. And Linnæus obſerves, that ſome figs have the navel of the receptacle open; which was one reaſon that induced him to remove this plant from the claſs Clandeſtine Marriage to the claſs Polygamy. Lin. Spec. Plant.

From all theſe circumſtances I ſhould conjecture that thoſe female fig-flowers, which are cloſed on all ſides in the fruit or receptacle without any

So ſleeps in ſilence the Curculio, ſhut
In the dark chambers of the cavern'd nut,
Erodes with ivory beak the vaulted ſhell,
And quits, on filmy wings, its narrow cell.
So the pleaſed Linnet, in the moſs-wove neſt, 435
Waked into life beneath its parent's breaſt,
Chirps in the gaping ſhell, burſts forth erelong,
Shakes its new plumes, and tries its tender ſong.—
—And now the taliſman ſhe ſtrikes, that charms
Her huſband-Sylph,—and calls him to her arms.— 440
Quick, the light Gnat her airy Lord beſtrides,
With cobweb reins the flying courſer guides,
From cryſtal ſteeps of viewleſs ether ſprings,
Cleaves the ſoft air on ſtill expanded wings;
Darts like a ſunbeam o'er the boundleſs wave, 445
And ſeeks the beauty in her *ſecret* cave.
So with quick impulſe through all Nature's frame
Shoots the electric air its ſubtle flame.
So turns the impatient needle to the pole,
Tho' mountains riſe between, and oceans roll. 450

Where round the Orcades white torrents roar,
Scooping with ceaſeleſs rage the incumbent ſhore,
Wide o'er the deep a duſky cavern bends
Its marble arms, and high in air impends;

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male ones, are monſters, which have been propagated for their fruit, like barberries, and grapes without ſeeds in them; and that the Caprification is either an ancient proceſs of imaginary uſe, and blindly followed in ſome countries, or that it may contribute to ripen the fig by decreaſing its vigour, like cutting off a circle of the bark from the branch of a pear-tree. Tournefort ſeems inclined to this opinion; who ſays, that the figs in Provence and at Paris ripen ſooner if their buds be pricked with a ſtraw dipped in olive-oil. Plumbs and pears punctured by ſome inſect ripen ſooner, and the part round the puncture is ſweeter. Is not the honey-dew produced by the puncture of inſects? Will not wounding the branch of a pear-tree, which is too vigorous, prevent the bloſſoms from falling off; as from ſome fig-trees the fruit is ſaid to fall off unleſs they are wounded by caprification? I had laſt ſpring ſix young trees of the Iſchia fig, with fruit on them; in pots in a ſtove; on removing them into larger boxes, they protruded very vigorous ſhoots, and the figs all fell off; which I aſcribed to the increaſed vigour of the plants.

Baſaltic piers the ponderous roof ſuſtain, 455
And ſteep their maſſy ſandals in the main;
Round the dim walls, and through the whiſpering ailes,
Hoarſe breathes the wind, the glittering water boils.
Here the charm'd BYSSUS, with his blooming bride,
Spreads his green ſails, and braves the foaming tide; 460
The ſtar of Venus gilds the twilight wave,
And lights her votaries to the *ſecret* cave;
Light Cupids flutter round the nuptial bed,
And each coy Sea-maid hides her bluſhing head.

Where cool'd by rills, and curtain'd round by woods, 465
Slopes the green dell to meet the briny floods,
The ſparkling noon-beams trembling on the tide,
The PROTEUS-LOVER woos his playful bride,
To win the fair he tries a thouſand forms,
Baſks on the ſands, or gambols in the ſtorms. 470

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*Baſaltic piers.* l. 455. This deſcription alludes to the cave of Fingal, in the iſland of Staffa. The baſaltic columns, which compoſe the Giants Cauſeway on the coaſt of Ireland, as well as thoſe which ſupport the cave of Fingal, are evidently of volcanic origin, as is well illuſtrated in an ingenious paper of Mr. Keir, in the Philoſ. Tranſ. who obſerved in the glaſs, which had been long in a fuſing heat at the bottom of the pots in the glaſs-houſes at Stourbridge, that cryſtals were produced of a form ſimilar to the parts of the baſaltic columns of the Giants Cauſeway.

*Byſſus.* l. 459. Clandeſtine Marriage. It floats on the ſea in the day, and ſinks a little during the night; it is found in caverns on the northern ſhores, of a pale green colour, and as thin as paper.

*The Proteus-lover.* l. 468. Conferva polymorpha. This vegetable is put amongſt the cryptogamia, or clandeſtine marriages, by Linnæus; but, according to Mr. Ellis, the males and females are on different plants. Philoſ. Tranſ. vol. lvii. It twice changes its colour, from red to brown, and then to black; and changes its form by loſing its lower leaves, and elongating ſome of the upper ones, ſo as to be miſtaken by the unſkilful for different plants. It grows on the ſhores of this country.

There is another plant, Medicago polymorpha, which may be ſaid to aſſume a great variety of ſhapes; as the ſeed-veſſels reſemble ſometimes ſnail-horns, at other times caterpillars with or without long hair upon them; by which means it is probable they ſometimes elude the depredations of thoſe inſects. The ſeeds of Calendula, Marigold, bend up like a hairy caterpillar, with their prickles briſtling outwards, and may thus deter ſome birds or inſects from preying upon them. Salicornia alſo aſſumes an animal ſimilitude. Phil. Bot. p. 87. See note on Iris in additional notes; and Cypripedia, in Part I.

A Dolphin now, his ſcaly ſides he laves,
And bears the ſportive Damſel on the waves;
She ſtrikes the cymbal as he moves along,
And wondering Ocean liſtens to the ſong.
—And now a ſpotted Pard the lover ſtalks,
Plays round her ſteps, and guards her favour'd walks;
As with white teeth he prints her hand, careſs'd,
And lays his velvet paw upon her breaſt,
O'er his round face her ſnowy fingers ſtrain
The ſilken knots, and fit the ribbon-rein.
—And now a Swan, he ſpreads his plumy ſails,
And proudly glides before the fanning gales;
Pleaſed on the flowery brink, with graceful hand,
She waves her floating lover to the land;
Bright ſhines his ſinuous neck, with crimſon beak
He prints fond kiſſes on her glowing cheek,
Spreads his broad wings, elates his ebon creſt,
And claſps the beauty to his downy breſt.

A *hundred* virgins join a *hundred* ſwains,
And fond ADONIS leads the ſprightly trains;
Pair after pair, along his ſacred groves
To Hymen's fane the bright proceſſion moves;
Each ſmiling youth a myrtle garland ſhades,
And wreaths of roſes veil the bluſhing maids;
Light Joys on twinkling feet attend the throng,
Weave the gay dance, or raiſe the frolic ſong;

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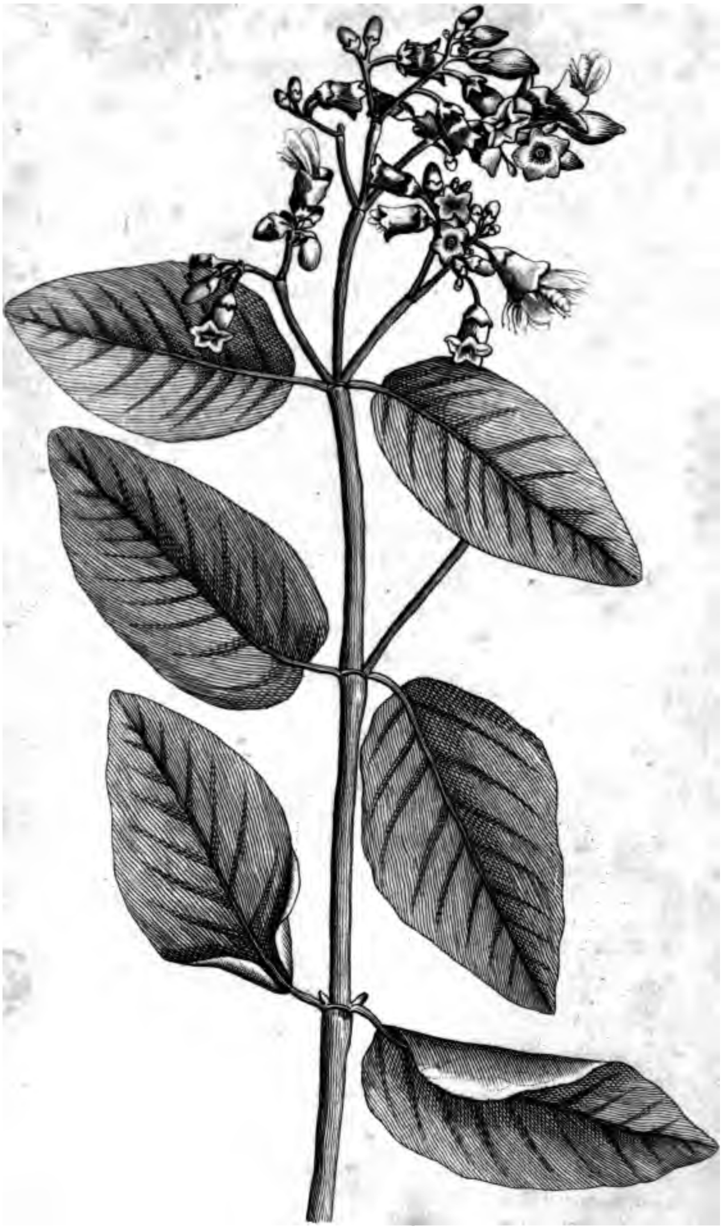
*Adonis.* l. 490. Many males and many females live together in the ſame flower. It may ſeem a ſoleciſm in language, to call a flower, which contains many of both ſexes, an individual; and the more ſo to call a tree or ſhrub an individual, which conſiſts of ſo many flowers. Every tree, indeed, ought to be conſidered as a family or ſwarm of its reſpective buds; but the buds themſelves ſeem to be individual plants; becauſe each has leaves or lungs appropriated to it; and the bark of the tree is only a congeries of the roots of all theſe individual buds. Thus hollow oak-trees and willows are often ſeen with the whole wood decayed and gone, and yet the few remaining branches flouriſh with vigour; but in reſpect to the male and female parts of a flower, they do not deſtroy its individuality any more than the number of paps of a ſow, or the number of her cotyledons, each of which includes one of her young.

The ſociety called the Areoi, in the iſland of Otaheite, conſiſts of about 100 males and 100 females, who form one promiſcuous marriage.

—Thick, as they paſs, exulting Cupids fling
Promiſcuous arrows from the ſounding ſtring;
On wings of goſſamer ſoft Whiſpers fly,
And the ſly Glance ſteals ſide-long from the eye. 500
—As round his ſhrine the gaudy circles bow,
And ſeal with muttering lips the faithleſs vow,
Licentious Hymen joins their mingled hands,
And looſely twines the meretricious bands.—
Thus where pleaſed VENUS, in the ſouthern main, 505
Sheds all her ſmiles on Otaheite's plain,
Wide o'er the iſle her ſilken net ſhe draws,
And the Loves laugh at all but Nature's laws."

Here ceaſed the Goddeſs,—o'er the ſilent ſtrings
Applauding Zephyrs ſwept their fluttering wings; 510
Enraptured Sylphs aroſe in murmuring crowds
To air-wove canopies and pillowy clouds;
Each Gnome reluctant ſought his earthy cell,
And each chill Floret clos'd her velvet bell.
Then, on ſoft tiptoe, NIGHT approaching near 515
Hung o'er the tuneleſs lyre his ſable ear;
Gem'd with bright ſtars the ſtill ethereal plain,
And bade his Nightingales repeat the ſtrain.



Banor. sc.

Apocynum androsæmifolium.

# THE
# BOTANIC GARDEN.

## ADDITIONAL NOTES.

P. 14. *Additional note to Curcuma.* THESE antherleſs filaments ſeem to be an endeavour of the plant to produce more ſtamens, as would appear from ſome experiments of M. Reynier, inſtituted for another purpoſe: he cut away the ſtamens of many flowers, with deſign to prevent their fecundity, and in many inſtances the flower threw out new filaments from the wounded part, of different lengths, but did not produce new anthers. The experiments were made on the geum rivale, different kinds of mallows, and the æchinops citro. Critical Review for March, 1788.

P. 15. *Addition to the note on Iris.* In the Perſian Iris the end of the lower petal is purple, with white edges and orange ſtreaks, creeping, as it were, into the mouth of the flower like an inſect; by which deception in its native climate it probably prevents a ſimilar inſect from plundering it of its honey; the edges of the lower petal lap over thoſe of the upper one, which prevents it from opening too wide on fine days, and facilitates its return at night; whence the rain is excluded, and the air admitted. See Polymorpha, Rubia, and Cypripedia, in Part I.

P. 17. *Additional note on Chondrilla.* In the natural ſtate of the expanded flower of the barberry, the ſtamens lie on the petals; under the concave ſummits of which the anthers ſhelter themſelves, and in this ſituation remain perfectly rigid; but on touching the inſide of the filament near its baſe with a fine briſtle, or blunt needle, the ſtamen inſtantly bends upwards, and the anther, embracing the ſtigma, ſheds its duſt. Obſervations on the Irritation of Vegetables, by T. E. Smith, M. D.

P. 19. *Addition to the note on Silene.* I ſaw a plant of the Dionæa Muſcipula, Fly-trap of Venus, this day, in the collection of Sir B. Boothby, at Aſhburn-Hall, Derbyſhire, Aug. 20th, 1788; and on drawing a ſtraw along the middle of the rib of the leaves as they lay upon the ground round the ſtem, each of them, in about a ſecond of time, cloſed and doubled itſelf up, croſſing the thorns over the oppoſite edge of the leaf, like the teeth of a ſpring rat-trap: of this plant I was favoured with an elegant coloured drawing, by Miſs Maria Jackſon, of Tarporly, in Cheſhire, a Lady who adds much botanical knowledge to many other elegant acquirements.

In the Apocynum Androſæmifolium, one kind of Dog's bane, the anthers converge over the nectaries, which conſiſt of five glandular oval corpuſcles ſurrounding the germ; and, at the ſame time, admit air to the nectaries at the interſtice between each anther. But when a fly inſerts its proboſcis between theſe anthers to plunder the honey, they converge cloſer, and with ſuch violence as to detain the fly, which thus generally periſhes. This account was related to me by R. W. Darwin, Eſq. of Elſton, in Nottinghamſhire, who ſhowed me the plant in flower, July 2d, 1788, with a fly thus held faſt by the end of its proboſcis, and was well ſeen by a magnifying lens, and which, in vain, repeatedly ſtruggled to diſengage itſelf, till the converging anthers were ſeparated by means of a pin: on ſome days he had obſerved that almoſt every flower of this elegant plant had a fly in it thus entangled; and, a few weeks afterwards, favoured me with his further obſervations on this ſubject.

" My Apocynum is not yet out of flower. I have often viſited it, and " have frequently found four or five flies, ſome alive, and ſome dead, in its " flowers; they are generally caught by the trunk or proboſcis, ſometimes " by the trunk and a leg: there is one at preſent only caught by a leg. " I don't know that this plant ſleeps, as the flowers remain open in the " night; yet the flies frequently make their eſcape. In a plant of Mr. Or- " doyno's, an ingenious gardener at Newark, who is poſſeſſed of a great col- " lection of plants, I ſaw many flowers of an Apocynum with three dead " flies in each: they are a thin-bodied fly, and rather leſs than the common " houſe-fly; but I have ſeen two or three other ſorts of flies thus arreſted " by the plant. Aug. 12, 1788."

P. 21. *Additional note on Ilex.* The efficient cauſe which renders the hollies prickly, in Needwood Foreſt, only as high as the animals can reach them, may ariſe from the lower branches being conſtantly cropped by them, and thus ſhoot forth more luxuriant foliage: it is probable the ſhears in garden-hollies may produce the ſame effect, which is equally curious, as prickles are not thus produced on other plants.

P. 35. *Additional note on Ulva.* M. Hubert made ſome obſervations on the air contained in the cavities of the bambou. The ſtems of theſe canes were from 40 to 50 feet in height, and 4 or 5 inches in diameter, and might contain about 30 pints of elaſtic air. He cut a bambou, and introduced a lighted candle into the cavity, which was extinguiſhed immediately on its entrance. He tried this about 60 times in a cavity of the bambou, containing about two pints. He introduced mice at different times into theſe cavities, which ſeemed to be ſomewhat affected, but ſoon recovered their agility. The ſtem of the bambou is not hollow till it riſes more than one foot from the earth; the diviſions between the cavities are convex downwards. Obſerv. ſur la Phyſique, par M. Rozier, l. 33, p. 130.

P. 103. *Addition to the note on Tropæolum.* In Sweden a very curious phenomenon has been obſerved on certain flowers, by M. Haggren, Lecturer in Natural Hiſtory. One evening he perceived a faint flaſh of light repeatedly dart from a Marigold: ſurprized at ſuch an uncommon appearance, he reſolved to examine it with attention; and, to be aſſured that it was no deception of the eye, he placed a man near him, with orders to make a ſignal at the moment when he obſerved the light. They both ſaw it conſtantly at the ſame moment.

The light was moſt brilliant on Marigolds, of an orange or flame colour; but ſcarcely viſible on pale ones.

The flaſh was frequently ſeen on the ſame flower two or three times in quick ſucceſſion, but more commonly at intervals of ſeveral minutes; and when ſeveral flowers in the ſame place emitted their light together, it could be obſerved at a conſiderable diſtance.

This phenomenon was remarked in the months of July and Auguſt, at ſun-ſet, and for half an hour after, when the atmoſphere was clear; but after a rainy day, or when the air was loaded with vapours, nothing of it was ſeen.

The following flowers emitted flaſhes more or leſs vivid, in this order;

1. The Marigold, (*Calendula Officinalis*).
2. Garden Naſturtion, (*Tropæolum majus*).
3. Orange Lily, (*Lilium bulbiferum*).
4. African Marigold, (*Tagetes patula et erecta*).

Sometimes it was alſo obſerved on the Sun-flowers, (*Helianthus annuus*). But bright yellow, or flame colour, ſeemed in general neceſſary for the production of this light; for it was never ſeen on the flowers of any other colour.

To diſcover whether ſome little inſects, or phoſphoric worms, might not be the cauſe of it, the flowers were carefully examined even with a microſcope, without any ſuch being found.

From the rapidity of the flaſh, and other circumſtances, it might be conjectured, that there is ſomething of electricity in this phenomenon. It is well known, that when the *piſtil* of a flower is impregnated, the *pollen* burſts away by its elaſticity, with which electricity may be combined. But M. Haggren, after having obſerved the flaſh from the Orange-lily, the *anthers* of which are a conſiderable ſpace diſtant from the *petals*, found that the light proceeded from the *petals* only; whence he concludes that this electric light is cauſed by the *pollen*, which, in flying off, is ſcattered upon the *petals*.— Obſer. Phyſique par M. Rozier, vol. xxxiii. p. 111.

## *Deſcription of the* Poiſon-Tree *in the Iſland of* JAVA. *Tranſlated from the original Dutch of* N. P. Foerſch.

THIS deſtructive tree is called, in the Malayan language, *Bohon-Upas*, and has been deſcribed by naturaliſts; but their accounts have been ſo tinctured with the *marvellous*, that the whole narration has been ſuppoſed to be an ingenious fiction by the generality of readers. Nor is this in the leaſt degree ſurpriſing, when the circumſtances, which we ſhall faithfully relate in this deſcription, are conſidered.

I muſt acknowledge, that I long doubted the exiſtence of this tree, until a ſtricter inquiry convinced me of my error. I ſhall now only relate ſimple unadorned facts, of which I have been an eye-witneſs. My readers may depend upon the fidelity of this account. In the year 1774, I was ſtationed at Batavia, as a ſurgeon, in the ſervice of the Dutch Eaſt-India Company. During my reſidence there, I received ſeveral different accounts of the Bohon-Upas, and the violent effects of its poiſon. They all then ſeemed incredible to me, but raiſed my curioſity in ſo high a degree, that I reſolved to inveſtigate this ſubject thoroughly, and to truſt only to *my own obſervations*. In conſequence of this reſolution, I applied to the Governor-General, Mr. Petrus Albertus van der Parra, for a paſs to travel through the country: my requeſt was granted; and, having procured every information, I ſet out on my expedition. I had procured a recommendation from an old Malayan prieſt to another prieſt, who lives on the neareſt inhabitable ſpot to the tree, which is about fifteen or ſixteen miles diſtant. The letter proved of great ſervice to me in my undertaking, as that prieſt is appointed by the Emperor to reſide there, in order to prepare for eternity the ſouls of thoſe who, for different crimes, are ſentenced to approach the tree, and to procure the poiſon.

The *Bohon-Upas* is ſituated in the iſland of *Java*, about twenty-ſeven leagues from *Batavia*, fourteen from *Soura-Charta*, the ſeat of the Emperor, and between eighteen and twenty leagues from *Tinkjoe*, the preſent reſidence of the Sultan of Java. It is ſurrounded on all ſides by a circle of high hills and mountains; and the country round it, to the diſtance of ten or twelve miles from the tree, is entirely barren. Not a tree, nor a ſhrub, nor even the leaſt plant or graſs, is to be ſeen. I have made the tour all around this dangerous ſpot, at about eighteen miles diſtant from the centre, and I found the aſpect of the country on all ſides equally dreary. The eaſieſt aſcent of the hills is from that part where the old eccleſiaſtic dwells. From his houſe the criminals are ſent for the poiſon, into which the points of all warlike inſtruments are dipped. It is of high value, and produces a conſiderable revenue to the Emperor.

### *Account of the manner in which the Poiſon is procured.*

The poiſon which is procured from this tree, is a gum that iſſues out between the bark and the tree itſelf, like the *camphor*. Malefactors who, for their crimes, are ſentenced to die, are the only perſons who fetch the poiſon; and this is the only chance they have of ſaving their lives. After ſentence is pronounced upon them by the judge, they are aſked in court, whether they will die by the hands of the executioner, or whether they will go to the Upas tree for a box of poiſon? They commonly prefer the latter propoſal, as there is not only ſome chance of preſerving their lives, but alſo a certainty, in caſe of their ſafe return, that a proviſion will be made for them in future by the Emperor. They are alſo permitted to aſk a favour from the Emperor, which is generally of a trifling nature, and commonly granted. They are then provided with a ſilver or tortoiſeſhell box, in which they are to put the poiſonous gum, and are properly inſtructed how to proceed while they are upon their dangerous expedition. Among other particulars, they are always told to attend to the direction of the winds; as they are to go towards the tree before the wind, ſo that the effluvia from the tree are always blown from them. They are told, likewiſe, to travel with the utmoſt diſpatch, as that is the only method of inſuring a ſafe return. They are aſterwards ſent to the houſe of the old prieſt, to which place they are commonly attended by their friends and relations. Here they generally remain ſome days, in expectation of a favourable breeze. During that time the eccleſiaſtic prepares them for their future fate by prayers and admonitions.

When the hour of their departure arrives, the prieſt puts on them a long leather-cap, with two glaſſes before their eyes, which comes down as far as their breaſt; and alſo provides them with a pair of leather gloves. They are then conducted by the prieſt, and their friends and relations, about two miles on their journey. Here the prieſt repeats his inſtructions, and tells them where they are to look for the tree. He ſhews them a hill, which they are told to aſcend, and that on the other ſide they will find a rivulet which they are to follow, and which will conduct them directly to the Upas. They now take leave of each other; and, amidſt prayers for their ſucceſs, the delinquents haſten away.

The worthy old eccleſiaſtic has aſſured me, that during his reſidence there, for upwards of thirty years, he had diſmiſſed above ſeven hundred criminals in the manner which I have deſcribed; and that ſcarcely two out of twenty have returned. He ſhewed me a catalogue of all the unhappy ſufferers, with the date of their departure from his houſe annexed; and a liſt of the offences for which they had been condemned: to which was added, a liſt of thoſe who had returned in ſafety. I afterwards ſaw another liſt of theſe culprits, at the jail-keeper's, at *Soura-Charta*, and found that they perfectly correſponded with each other, and with the different informations which I afterwards obtained.

I was preſent at ſome of theſe melancholy ceremonies, and deſired different delinquents to bring with them ſome pieces of the wood, or a ſmall branch, or ſome leaves, of this wonderful tree. I have alſo given them ſilk cords, deſiring them to meaſure its thickneſs. I never could procure more than two dry leaves that were picked up by one of them on his return; and all I could learn from him, concerning the tree itſelf, was, that it ſtood on the border of a rivulet, as deſcribed by the old prieſt; that it was of a middling ſize; that five or ſix young trees of the ſame kind ſtood cloſe by it; but that no other ſhrub or plant could be ſeen near it; and that the ground was of a browniſh ſand, full of ſtones, almoſt impracticable for travelling, and covered with dead bodies. After many converſations with the old Malayan prieſt, I queſtioned him about the firſt diſcovery, and aſked his opinion of this dangerous tree; upon which he gave me the following anſwer:

“ We are told in our new Alcoran, that, above an hundred years ago, the “ country around the tree was inhabited by a people ſtrongly addicted to the “ ſins of Sodom and Gomorrha; when the great Prophet Mahomet deter- “ mined not to ſuffer them to lead ſuch deteſtable lives any longer, he applied “ to God to puniſh them: upon which God cauſed this tree to grow out of “ the earth, which deſtroyed them all, and rendered the country for ever “ uninhabitable.”

Such was the Malayan opinion. I ſhall not attempt to comment; but muſt obſerve, that all the Malayans conſider this tree as an holy inſtrument of the great prophet to puniſh the ſins of mankind; and, therefore, to die of the poiſon of the Upas is generally conſidered among them as an honourable death. For that reaſon I alſo obſerved, that the delinquents, who were going to the tree, were generally dreſſed in their beſt apparel.

This, however, is certain, though it may appear incredible, that from fifteen to eighteen miles round this tree, not only no human creature can exiſt, but that, in that ſpace of ground, no living animal of any kind has ever been diſcovered. I have alſo been aſſured by ſeveral perſons of veracity, that there are no fiſh in the waters, nor has any rat, mouſe, or any other vermin, been ſeen there; and when any birds fly ſo near this tree, that the effluvia reaches them, they fall a ſacrifice to the effects of the poiſon. This circumſtance has been aſcertained by different delinquents, who, in their return, have ſeen the birds drop down, and have picked them up *dead*, and brought them to the old eccleſiaſtic.

I will here mention an inſtance, which proves the fact beyond all doubt, and which happened during my ſtay at Java.

In the year 1775, a rebellion broke out among the ſubjects of the Maſſay, a ſovereign prince, whoſe dignity is nearly equal to that of the Emperor. They refuſed to pay a duty impoſed upon them by their ſovereign, whom they openly oppoſed. The Maſſay ſent a body of a thouſand troops to diſperſe the rebels, and to drive them, with their families, out of his dominions. Thus four hundred families, conſiſting of above ſixteen hundred ſouls, were obliged to leave their native country. Neither the Emperor nor the Sultan would give them protection, not only becauſe they were rebels, but alſo through fear of diſpleaſing their neighbour, the Maſſay. In this diſtreſsful ſituation, they had no other reſource than to repair to the uncultivated parts round the Upas, and requeſted permiſſion of the Emperor to ſettle there. Their requeſt was granted, on condition of their fixing their abode not more than twelve or fourteen miles from the tree, in order not to deprive the inhabitants already ſettled there, at a greater diſtance, of their cultivated lands. With this they were obliged to comply; but the conſequence was, that in leſs than two months their number was reduced to about three hundred. The chiefs of thoſe who remained returned to the Maſſay, informed him of their loſſes, and intreated his pardon, which induced him to receive them again as ſubjects, thinking them ſufficiently puniſhed for their miſconduct. I have ſeen and converſed with ſeveral of thoſe who ſurvived, ſoon after their return. They all had the appearance of perſons tainted with an infectious diſorder; they looked pale and weak, and, from the account which they gave of the loſs of their comrades, and of the ſymptoms and circumſtances which attended their diſſolution, ſuch as convulſions, and other ſigns of a violent death, I was fully convinced that they fell victims to the poiſon.

This violent effect of the poiſon at ſo great a diſtance from the tree certainly appears ſurpriſing, and almoſt incredible; and eſpecially, when we conſider that it is poſſible for delinquents who approach the tree to return alive. My wonder, however, in a great meaſure, ceaſed, after I had made the following obſervations:

I have ſaid before, that malefactors are inſtructed to go to the tree with the wind, and to return againſt the wind. When the wind continues to blow from the ſame quarter while the delinquent travels thirty, or ſix and thirty miles, if he be of a good conſtitution, he certainly ſurvives. But what proves the moſt deſtructive is, that there is no dependence on the wind in that part of the world for any length of time.—There are no regular land-winds; and the ſea-wind is not perceived there at all, the ſituation of the tree being at too great a diſtance, and ſurrounded by high mountains and uncultivated foreſts. Beſides, the wind there never blows a freſh regular gale, but is commonly merely a current of light, ſoft breezes, which paſs through the different openings of the adjoining mountains. It is alſo frequently difficult to determine from what part of the globe the wind really comes, as it is divided by various obſtructions in its paſſage, which eaſily change the direction of the wind, and often totally deſtroy its effects.

I, therefore, impute the diſtant effects of the poiſon, in a great meaſure, to the conſtant gentle winds in thoſe parts, which have not power enough to diſperſe the poiſonous particles. If high winds were more frequent and durable there, they would certainly weaken very much, and even deſtroy the obnoxious effluvia of the poiſon; but without them, the air remains infected and pregnant with theſe poiſonous vapours.

I am the more convinced of this, as the worthy eccleſiaſtic aſſured me, that a dead calm is always attended with the greateſt danger, as there is a continual perſpiration iſſuing from the tree, which is ſeen to riſe and ſpread in the air, like the putrid ſteam of a marſhy cavern.

### *Experiments made with the* Gum *of the* Upas-Tree.

In the year 1776, in the month of February, I was preſent at the execution of thirteen of the Emperor's concubines, at *Soura-Charta*, who were convicted of infidelity to the Emperor's bed. It was in the forenoon, about eleven o'clock, when the fair criminals were led into an open ſpace, within the walls of the Emperor's palace. There the judge paſſed ſentence upon them, by which they were doomed to ſuffer death by a lancet, poiſoned with Upas. After this the Alcoran was preſented to them, and they were, according to the law of their great prophet Mahomet, to acknowledge and to affirm by oath, that the charges brought againſt them, together with the ſentence and their puniſhment, were fair and equitable. This they did, by laying their right hand upon the Alcoran, their left hand upon their breaſt, and their eyes lifted towards heaven; the judge then held the Alcoran to their lips, and they kiſſed it.

Theſe ceremonies over, the executioner proceeded on his buſineſs in the following manner:—Thirteen poſts, each about five feet high, had been previouſly erected. To theſe the delinquents were faſtened, and their breaſts ſtripped naked. In this ſituation they remained a ſhort time in continual prayers, attended by ſeveral prieſts, until a ſignal was given by the judge to the executioner; on which the latter produced an inſtrument, much like the ſpring lancet uſed by farriers for bleeding horſes. With this inſtrument, it being poiſoned with the gum of the Upas, the unhappy wretches were lanced in the middle of their breaſts, and the operation was performed upon them all in leſs than two minutes.

My aſtoniſhment was raiſed to the higheſt degree, when I beheld the ſudden effects of that poiſon; for in about five minutes after they were lanced they were taken with a *tremor*, attended with a *ſubſultus tendinum*, after which they died in the greateſt agonies, crying out to God and Mahomet for mercy. In ſixteen minutes by my watch, which I held in my hand, all the criminals were no more. Some hours after their death, I obſerved their bodies full of livid ſpots, much like thoſe of the *Petechia*, their faces ſwelled, their colour changed to a kind of blue, their eyes looked yellow, &c. &c.

About a fortnight after this I had an opportunity of ſeeing ſuch another execution at Samarang. Seven Malays were executed there with the ſame inſtrument, and in the ſame manner; and I found the operation in the poiſon, and the ſpots in their bodies, exactly the ſame.

Theſe circumſtances made me deſirous to try an experiment with ſome animals, in order to be convinced of the real effects of this poiſon; and as I had then two young puppies, I thought them the fitteſt objects for my purpoſe. I accordingly procured, with great difficulty, ſome grains of Upas. I diſſolved half a grain of that gum in a ſmall quantity of arrack, and dipped a lancet into it. With this poiſoned inſtrument I made an inciſion in the lower muſcular part of the belly in one of the puppies. Three minutes after it received the wound the animal began to cry out moſt piteouſly, and ran as faſt as poſſible from one corner of the room to the other. So it continued during ſix minutes, when all its ſtrength being exhauſted, it fell upon the ground, was taken with convulſions, and died in the eleventh minute. I repeated this experiment with two other puppies, with a cat and a fowl, and found the operation of the poiſon in all of them the ſame: none of theſe animals ſurvived above thirteen minutes.

I thought it neceſſary to try alſo the effect of the poiſon given inwardly, which I did in the following manner. I diſſolved a quarter of a grain of the gum in half an ounce of arrack, and made a dog of ſeven months old drink it. In ſeven minutes a retching enſued, and I obſerved, at the ſame time, that the animal was delirious, as it ran up and down the room, fell on the ground, and tumbled about; then it roſe again, cried out very loud, and in about half an hour after was ſeized with convulſions, and died. I opened the body, and found the ſtomach very much inflamed, as the inteſtines were in ſome parts, but not ſo much as the ſtomach. There was a ſmall quantity of coagulated blood in the ſtomach; but I could diſcover no orifice from which it could have iſſued; and therefore ſuppoſed it to have been ſqueezed out of the lungs, by the animal's ſtraining while it was vomiting.

From theſe experiments I have been convinced that the gum of the Upas is the moſt dangerous and moſt violent of all vegetable poiſons; and I am apt to believe that it greatly contributes to the unhealthineſs of that iſland. Nor is this the only evil attending it: hundreds of the natives of Java, as well as Europeans, are yearly deſtroyed and treacherouſly murdered by that poiſon, either internally or externally. Every man of quality or faſhion has his dagger or other arms poiſoned with it; and in times of war the Malayans poiſon the ſprings and other waters with it. By this treacherous practice the Dutch ſuffered greatly during the laſt war, as it occaſioned the loſs of half their army. For this reaſon they have ever ſince kept fiſh in the ſprings of which they drink the water, and ſentinels are placed near them, who inſpect the waters every hour, to ſee whether the fiſh are alive. If they march with an army or body of troops into an enemy's country, they always carry live fiſh with them, which they throw into the water ſome hours before they venture to drink it; by which means they have been able to prevent their total deſtruction.

This account, I flatter myſelf, will ſatisfy the curioſity of my readers, and the few facts which I have related will be conſidered as a certain proof of the exiſtence of this pernicious tree, and its penetrating effects.

If it be aſked why we have not yet any more ſatisfactory accounts of this tree, I can only anſwer, that the object of moſt travellers to that part of the world conſiſts more in commercial purſuits than in the ſtudy of Natural Hiſtory and the advancement of Sciences. Beſides, Java is ſo univerſally reputed an unhealthy iſland, that rich travellers ſeldom make any long ſtay in it; and others want money, and generally are too ignorant of the language to travel, in order to make inquiries. In future, thoſe who viſit this iſland will now probably be induced to make it an object of their reſearches, and will furniſh us with a fuller deſcription of this tree.

I will therefore only add, that there exiſts alſo a ſort of Cajoe-Upas on the coaſt of Macaſſer, the poiſon of which operates nearly in the ſame manner, but is not half ſo violent or malignant as that of Java, and of which I ſhall likewiſe give a more circumſtantial account in a deſcription of that iſland.—*London Magazine.*

### *Another Account of the* Boa Upas, *or* Poiſon-Tree *of* Macaſſer, *from an inaugural Diſſertation publiſhed by* Chriſt. Aejmelæus, *and approved by* Profeſſor Thunberg, *at* Upſal.

DOCTOR Aejmelæus firſt ſpeaks of poiſons in general, enumerating many virulent ones from the mineral and animal, as well as from the vegetable kingdoms of Nature. Of the firſt he mentions arſenical, mercurial, and antimonial preparations; amongſt the ſecond he mentions the poiſons of ſeveral ſerpents, fiſhes, and inſects; and amongſt the laſt the Curara on the bank of the Oronoko, and the Woorara on the banks of the Amazones, and many others. But he thinks the ſtrongeſt is that of a tree hitherto undeſcribed, known by the name of Boa Upas, which grows in many of the warmer parts of India, principally in the iſlands of Java, Sumatra, Borneo, Bali, Macaſſer, and Celebes.

Rumphius teſtifies concerning this Indian poiſon, that it was more terrible to the Dutch then any warlike inſtrument; it is by him ſtyled Arbor toxicaria, and he mentions two ſpecies of it, which he terms male and female; and deſcribes the tree as having a thick trunk, with ſpreading branches, covered with a rough dark bark. The wood, he adds, is very ſolid, of a pale yellow, and variegated with black ſpots; but the fructification is yet unknown.

Profeſſor Thunberg ſuppoſes the Boa Upas to be a Ceſtrum, or a tree of the ſame natural family; and deſcribes a Ceſtrum of the Cape of Good-Hope, the juice of which the Hottentots mix with the venom of a certain ſerpent, which is ſaid to increaſe the deleterious quality of them both.

The Boa Upas tree is eaſily recogniſed at a diſtance, being always ſolitary, the ſoil around it being barren, and, as it were, burnt up; the dried juice is dark brown, liquifying by heat, like other reſins. It is collected with the greateſt caution, the perſon having his head, hands, and feet carefully covered with linen, that his whole body may be protected from the vapour as well as from the droppings of the tree. No one can approach ſo near as to gather the juice, hence they ſupply bamboos, pointed like a ſpear, which they thruſt obliquely, with great force, into the trunk; the juice oozing out gradually fills the upper joint; and the nearer the root the wound is made, the more virulent the poiſon is ſuppoſed to be. Sometimes upwards of twenty reeds are left fixed in the tree for three or four days, that the juice may collect and harden in the cavities; the upper joint of the reed is then cut off from the remaining part, the concreted juice is formed into globules or ſticks, and is kept in hollow reeds, carefully cloſed, and wrapped in tenfold linen. It is every week taken out to prevent its becoming mouldy, which ſpoils it. The deleterious quality appears to be volatile, ſince it loſes much of its power in the time of one year, and in a few years becomes totally effete.

The vapour of the tree produces numbneſs and ſpaſms of the limbs, and if any one ſtands under it bare-headed, he loſes his hair; and if a drop falls on him, violent inflammation enſues. Birds which ſit on the branches a ſhort time, drop down dead, and can even with difficulty fly over it; and not only no vegetables grow under it, but the ground is barren a ſtone's caſt around it.

A perſon wounded by a dart poiſoned with this juice feels immediately a ſenſe of heat over his whole body, with great vertigo, to which death ſoon ſucceeds. A perſon wounded with the Java poiſon was affected with tremor of the limbs, and ſtarting of the tendons in five minutes, and died in leſs than ſixteen minutes, with marks of great anxiety; the corpſe, in a few hours, was covered with petechial ſpots, the face became tumid and lead-coloured, and the white part of the eye became yellow.

The natives try the ſtrength of their poiſon by a ſingular teſt; ſome of the expreſſed juice of the root of Amomum Zerumbet is mixed with a little water, and a bit of the poiſonous gum or reſin is dropped into it; an effervеſcence inſtantly takes place, by the violence of which they judge of the ſtrength of the poiſon.—What air can be extricated during this effervеſcence?—This experiment is ſaid to be dangerous to the operator.

As the juice is capable of being diſſolved in arrack, and is thence ſuppoſed to be principally of a reſinous nature, the Profeſſor does not credit that fountains have been poiſoned with it.

This poiſon has been employed as a puniſhment for capital crimes in

Macaſſer and other iſlands; in thoſe caſes ſome experiments have been made, and when a finger only had been wounded with a dart, the immediate amputation of it did not ſave the criminal from death.

The poiſon from what has been termed the female tree, is leſs deleterious than the other, and has been uſed chiefly in hunting; the carcaſes of animals thus deſtroyed are eaten with impunity. The poiſon-juice is ſaid to be uſed externally as a remedy againſt other poiſons, in the form of a plaſter; alſo to be uſed internally for the ſame purpoſe; and is believed to alleviate the pain, and extract the poiſon of venomous inſects ſooner than any other application. The author concludes that theſe accounts have been exaggerated by Mahomedan prieſts, who have perſuaded their followers that the Prophet Mahomet planted this noxious tree as a puniſhment for the ſins of mankind.

An abſtract of this Diſſertation of C. Aejmelæus is given in Dr. Duncan's Medical Commentaries for the year 1790, Decad. 2d. vol. v.

## FAIRY-SCENE

*From Mr. Mundy's Needwood Foreſt. Referred to in Canto* IV. l. 35.

HERE, ſeen of old, the *elfin* race
With ſprightly vigils mark'd the place;
Their gay proceſſions charm'd the ſight,
Gilding the lucid noon of night;
Or, when obſcure the midnight hour,
With glow-worm lantherns hung the bower.
—Hark!—the ſoft lute!—along the green
Moves with majeſtic ſtep the QUEEN!
Attendant Fays around her throng,
And trace the dance or raiſe the ſong;
Or touch the ſhrill reed, as they trip,
With finger light and ruby lip.

High, on her brow ſublime, is borne
One ſcarlet woodbine's tremulous horn;
A gaudy Bee-bird's* triple plume
Sheds on her neck its waving gloom;
With ſilvery goſſamer entwin'd
Stream the luxuriant locks behind.
Thin folds of tangled network break
In airy waves adown her neck;—
Warp'd in his loom, the ſpider ſpread
The far-diverging rays of thread,
Then round and round with ſhuttle fine
Inwrought the undulating line;—

---

* The *humming-bird.*

Scarce hides the woof her boſom's ſnow,
One pearly nipple peeps below.
One roſe-leaf forms her crimſon veſt,
The looſe edge croſſes o'er her breaſt;
And one tranſlucent fold, that fell
From the tall lily's ample bell,
Forms with ſweet grace her ſnow-white train,
Flows, as ſhe ſteps, and ſweeps the plain.
Silence and Night enchanted gaze,
And Heſper hides his vanquiſh'd rays!—

Now the waked reed-finch ſwells his throat,
And night-larks trill their mingled note;
Yet huſh'd in moſs with writhed neck
The blackbird hides his golden beak;
Charm'd from his dream of love he wakes,
Opes his gay eye, his plumage ſhakes,
And, ſtretching wide each ebon wing,
Firſt in low whiſpers tries to ſing;
Then ſounds his clarion loud, and thrills
The moon-bright lawns, and ſhadowy hills.
Silent the choral Fays attend,
And then their ſilver voices blend,
Each ſhining thread of ſound prolong,
And weave the magic woof of ſong.
Pleaſed Philomela takes her ſtand
On high, and leads the Fairy band,
Pours ſweet at intervals her ſtrain,
And guides with beating wing the train.
Whilſt interrupted Zephyrs bear
Hoarſe murmurs from the diſtant wear;
And at each pauſe is heard the ſwell
Of Echo's ſoft ſymphonious ſhell.

# THE
# BOTANIC GARDEN.

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OF THE
## POETIC EXHIBITION.

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THE END.

# ERRATA.

## PART I.

In the Argument of the fourth Canto, page 96, line 8, for '165,' read 177, and add 12 to each succeeding number of the lines throughout the page.

Page 185, l. 8 from the bottom, for 'porportion,' read proportion.
186, l. 2 of the note, for 'Porland,' read Portland.
198, l. 17, for 'ceystallization,' read crystallization.

## PART II.

Page 112, the following note should have been inserted at the bottom of the page.

*Ice-flower.* l. 239. Meſembryanthemum cryſtallinum.

## *Directions to the Binder for placing the Engravings.*

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☞ IT was the intention of the publiſhers of this work, agreeable to an article of their propoſals, to have inſerted, in this place, a liſt of the ſubſcribers' names; but it has been found impracticable, from the difficulty of collecting the ſubſcription-papers from every part of the United States, to comply with that article, without a very conſiderable delay in the publication. It has therefore been thought proper, from the preſſing demands for the book, to publiſh it at this time, and without any names; the omiſſion of the whole being deemed preferable to the inſertion of but a ſmall part of them.